COLUMBIA LIBRARIES OFFSITE
HEALTH SCIENCES RESTRICTED
HR02212749
RECAP

MEDICAL AND SURGICAL REPORTS

OF

THE BOSTON CITY HOSPITAL.

Tenth Series.

EDITED BY

HERBERT L. BURRELL, M.D., W. T. COUNCILMAN, M.D.,
AND CHARLES F. WITHINGTON, M.D.

BOSTON:
PUBLISHED BY THE TRUSTEES.
1899.

SERIAL v. 10
B 1898

Columbia University
in the City of New York

College of Physicians and Surgeons

Reference Library

MEDICAL AND SURGICAL REPORTS

OF THE

BOSTON CITY HOSPITAL.

Tenth Series.

EDITED BY

HERBERT L. BURRELL, M.D., W. T. COUNCILMAN, M.D.,
AND CHARLES F. WITHINGTON, M.D.

BOSTON:
PUBLISHED BY THE TRUSTEES.
1899.

Copyright 1899,
By The Trustees of the Boston City Hospital.

PREFACE.

THE tenth series of the Medical and Surgical Reports of the Boston City Hospital again appears as an annual publication. Although the size of the volume has not increased over former years, the editors have had the difficult task of selecting what they considered to be the most important articles from the large number contributed. The publication of a number of valuable articles has had to be postponed and a few articles rejected.

During the past two years the Hospital has increased in size so that at the present time there are the following number of beds in the Hospital:

Medical Service	181
Surgical "	227
Diseases of Women	55
Ophthalmic Service	6
Aural "	6
Mixed "	87
Contagious "	220
	782

A large number of soldiers from our army in Cuba, sick for the most part with typhoid and malarial fevers, were cared for by the Hospital during the late summer and autumn. A majority of these men were given accommodations in tents which were pitched on the lawn, west of the Pathological Building.

A closely laid floor was provided for each tent, with connecting platforms. This camp included three large tents, capable of holding about twenty-five beds each, besides a few smaller tents with four beds each, service and sanitary tents, and a marquée with provision for convalescents to lounge, smoke and read.

The camp was patterned in general upon the tent service which the Hospital has occasionally maintained during previous summers, but the accommodations were larger and more complete than have been before furnished in the open air.

As the autumn advanced a number of polling booths, affording a better protection against the cold, were substituted for some of the tents, and this camp continued to be occupied satisfactorily by the three medical services until the first snowstorm of the season found the number of soldier-patients so far reduced that they could be housed within the wards.

Since the publication of the eighth series the Hospital has lost by death, Dr. Benjamin E. Cotting, and has received the resignations of the following gentlemen: Drs. Charles F. Folsom, Benjamin Tenney and R. W. Lovett.

THE EDITORS.

BOSTON, May 1, 1899.

THE TRUSTEES.

A. SHUMAN, *President.*
CONRAD J. RUETER, *Secretary.*
HENRY H. SPRAGUE,
L. G. BURNHAM,
FRANCIS J. KEANY, M.D.

CONSULTING PHYSICIANS AND SURGEONS.

A. D. SINCLAIR, M.D. | WM. INGALLS, M.D.

THE MEDICAL AND SURGICAL STAFF.

Superintendent and Resident Physician.
G. H. M. ROWE, M.D.

VISITING STAFF.

Senior Surgeons.

D. W. CHEEVER, M.D. | GEO. W. GAY, M.D.

Visiting Physicians.

A. L. MASON, M.D. | FRANCIS H. WILLIAMS, M.D.
G. B. SHATTUCK, M.D. | CHAS. F. WITHINGTON, M.D.
E. M. BUCKINGHAM, M.D. | VINCENT Y. BOWDITCH, M.D.

Senior Visiting Surgeons.

WM. P. BOLLES, M.D. | ABNER POST, M.D.

Junior Visiting Surgeons.

M. F. GAVIN, M.D. | H. L. BURRELL, M.D.
FRANCIS S. WATSON, M.D.

Senior Visiting Physician for Diseases of Women.
JOHN G. BLAKE, M.D.

Junior Visiting Physician for Diseases of Women.
C. M. GREEN, M.D.

Visiting Ophthalmic Surgeon.
O. F. WADSWORTH, M.D.

Visiting Aural Surgeon.

J. Orne Green, M.D.

Visiting Pathologist.

W. T. Councilman, M.D.

Assistant Visiting Physician.

Henry Jackson, M.D. | George G. Sears, M.D.
John L. Morse, M.D.

First Assistant Visiting Surgeons.

H. W. Cushing, M.D. | George H. Monks, M.D.
R. W. Lovett, M.D.

Second Assistant Visiting Surgeons.

John C. Munro, M.D. | Paul Thorndike, M.D.
Edwin W. Dwight, M.D.

Third Assistant Visiting Surgeons.

J. Bapst Blake, M.D. | Fred B. Lund, M.D.
Edward H. Nichols, M.D.

First Assistant Visiting Physician for Diseases of Women.

George Haven, M.D.

Physicians for Diseases of the Nervous System.

Morton Prince, M.D. | Philip Coombs Knapp, M.D.
W. N. Bullard, M.D.

Physicians for Diseases of the Skin.

James S. Howe, M.D. | Geo. F. Harding, M.D.

Physicians for Diseases of the Throat.

Thos. Amory DeBlois, M.D. | J. W. Farlow, M.D.

OUT-PATIENT STAFF.

Physicians to Out-Patients.

John L. Ames, M.D. | H. D. Arnold, M.D.
John W. Bartol, M.D.

Second Assistant Visiting Physician for Diseases of Women.

Edward Reynolds, M.D.

Ophthalmic Surgeons.

Edwin E. Jack, M.D. | Walter B. Lancaster, M.D
John C. Bossidy, M.D.

Aural Surgeons.

Geo. A. Leland, M.D. | Ernest E. Doble, M.D.

Medico-Legal Pathologist.
F. W. Draper, M.D.

Assistant Visiting Pathologist.
F. B. Mallory, M.D.

Medical Registrar.
A. S. Knight, M.D.

Surgical Registrar.
J. Bapst Blake, M.D.

Physicians to the Convalescent Home.
C. Ellery Stedman, M.D. | Daniel D. Gilbert, M.D.
Edward T. Twitchell, M.D.

MEDICAL AND SURGICAL ASSISTANTS.

Assistants to the Ophthalmic Surgeons.
William J. Daly, M.D. | Charles F. Moulton, M.D.

Assistants to the Physicians for Diseases of the Nervous System.
John J. Thomas, M.D. | Joseph W. Courtney, M.D.

Assistant to the Aural Surgeons.
Edgar M. Holmes, M.D.

Assistant to the Physicians for Diseases of the Skin.
Harvey P. Towle, M.D.

Assistants to the Physicians for Diseases of the Throat.
Geo. A. Leland, M.D. | Rockwell A. Coffin, M.D.

Third Assistant Visiting Physician for Diseases of Women.
Frank A. Higgins, M.D.

First Assistant in Pathology.
R. M. Pearce, M.D.

Second Assistant in Pathology.
Joseph H. Pratt, M.D.

Assistant in Clinical Pathology.
J. Bergen Ogden, M.D.

HOSPITAL OFFICERS.

Superintendent.
G. H. M. Rowe, M.D.

First Executive Assistant.
Theron H. Carter, M.D.

Second Executive Assistant.
Charles S. Knight, M.D.

Third Executive Assistant.
Frederick W. Stetson, M.D.

Steward.
Samuel M. Nesmith, M.D.

Chemist.
Greenleaf R. Tucker, B.S.

Superintendent of Nurses and Matron.
Miss Lucy L. Drown.

SOUTH DEPARTMENT.

Resident Physician.
J. H. McCollom, M.D.

Assistant Resident Physicians.
David N. Blakely, M.D. | Fred G. Burrows, M.D.

Assistant Superintendent of Nurses and Matron.
Miss Mary M. Riddle.

CONVALESCENT HOME.

Matron.
Miss Elizabeth C. Fairbank.

CONTENTS.

		PAGE.
I.	Scarlatina. By John H. McCollom, M.D. . . .	1
II.	Scarlet Fever, its Bacteriology and Gross and Minute Anatomy. By Richard Mills Pearce, M.D. .	39
III.	Observations on the Weight of the "Normal" Heart in Adults in 216 Cases. By Horace D. Arnold, M.D.	83
IV.	Bone Tumor in the Human Brain Surrounding Encysted Coccidia Oviformia. By John Jenks Thomas, A.M., M.D.	102
V.	Two Cases of Infection with the Bacillus Capsulatus Mucosus Friedländer. By Lawrence Watson Strong, M.D.	117
VI.	Secondary Infection of the Skin and Subcutaneous Tissues by the Bacillus Typhosus. By Joseph H. Pratt, M.D.	124
VII.	Actinomycosis. By D. H. Walker, M.D.	130
VIII.	The Blood in Diphtheria. By John Lovett Morse, A.M., M.D.	138
IX.	A Review of the Diseases Contracted in the Cuban Campaign of 1898. One Hundred and Twenty-three Men. By Henry Jackson, M.D. . .	154
X.	Coincident Malaria and Typhoid Infections as Seen among Our Returned Soldiers. By Charles F. Withington, M.D.	181
XI.	Observations on Pneumohydrothorax and Pneumothorax. By F. H. Williams, M.D.	191
XII.	Syringomyelia: Glioma of the Spinal Cord. Laminectomy. By William N. Bullard, M.D. . . .	197
XIII.	Cases of Acute Abdominal Inflammation. By John C. Munro, M.D.	208
XIV.	An Apparatus for Maintaining Position in Fractures of both Bones of the Leg. By Robert W. Lovett, M.D.	222
XV.	A Case of Cantharides Poisoning with a Study of the Urine. By Ralph Emerson Stevens, M.D., House Physician, First Medical Service	225

I.

SCARLATINA.

By John H. McCollom, M.D.

The influence of scarlatina as compared with some of the other infectious diseases on the death-rate of Boston renders the study of the disease of importance not only in the line of preventive medicine, but also from a clinical point of view. No disease varies so much in severity as scarlet fever, and as is always the case with a contagious disease, the mild and unrecognized attacks are more dangerous to the public health than the severe. The positive diagnosis of a mild case is always difficult, and in some instances impossible. In Boston, for the past fifty-eight years, the ratio of deaths from scarlet fever per 10,000 of the living has varied from 26.04 to .53. In 1889 the lowest rate, that of .53, was reached. In the next year the rate was .94 per 10,000. Why in these two years there should be such an astonishingly low rate cannot be explained. A study of Chart 1, which shows the ratio of deaths from scarlatina per 10,000 of the living for seven years, 1892 to 1898, inclusive, shows that there has been a marked diminution in the past four years, which can only be explained by the fact that more cases have been treated in the hospital than in previous years.

A comparison of the ratio of mortality from scarlatina per 10,000 of the living, with that from diphtheria and typhoid fever may be of interest. Chart 2 shows the mortality ratios of these diseases for seven years, 1892 to 1898,

CHART 2. — Ratio of Deaths from Diphtheria, Scarlatina and Typhoid Fever per 10,000 of the Living in Boston, from 1892 to 1898.

Diphtheria ——. Scarlatina — — —. Typhoid Fever ═══

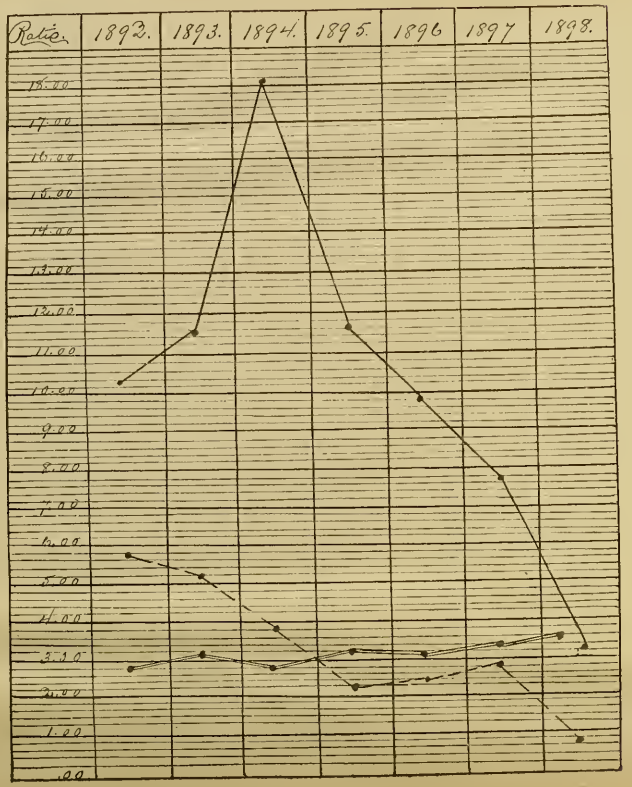
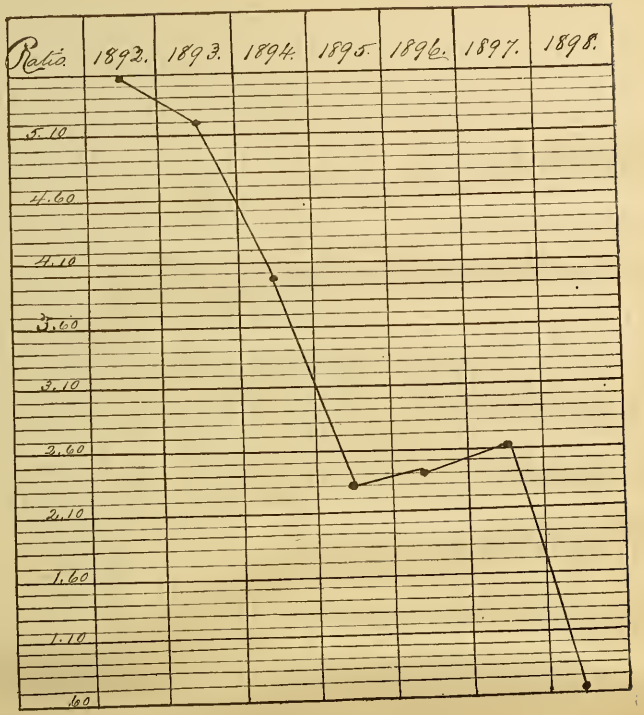


CHART 1. — Ratio of Deaths from Scarlatina per 10,000 of the Living in Boston, from 1892 to 1898.



inclusive. It will be seen that the rate from diphtheria is uniformly higher than that of scarlatina; that the rate of typhoid fever is nearly the same as that of scarlatina. The most marked diminution in the rate for scarlatina as compared with that of typhoid fever occurred in 1898, being in the former case .61 and in the latter case 3.41.

A comparison of the mortality ratios of scarlatina in some of the foreign cities as well as in some of the larger cities in this country shows that the rate in Boston is higher than in many of these other cities. Chart 3 shows the ratios in Boston, London, Liverpool, Glasgow, Paris and Berlin. It will be seen from this chart that Boston in 1893 had a higher rate than any of these foreign cities; that in 1895 the rate in Boston was lower than in Berlin, Glasgow, Liverpool, but the rate for Boston this same year was higher than that for London, and very considerably higher than that of Paris. The relative order of the ratio of these cities for 1897 was, Liverpool first, Boston next, then Glasgow, London, Berlin and Paris. It is impossible to understand why the rate in Paris should be so very low, lower than that of any of the other cities.

Chart 4 shows the ratios of deaths from scarlatina per 10,000 of the living in Boston, New York, Philadelphia, Brooklyn, Chicago and St. Louis from 1893 to 1897, inclusive. It will be seen from this chart that the ratio of Boston was higher than that of any of the other cities except in 1895 when the rate for Boston was very little lower than that of New York. In 1897 Boston had the highest rate, then came New York, Philadelphia, Brooklyn, Chicago, St. Louis. The rate for St. Louis is quite low, lower than that of any of the other cities. Chicago has a slightly higher rate than St. Louis, but not so high as that of Philadelphia. Why there should be such a difference between the rate for Brooklyn and that for New York it is impossible to explain. The rate for Boston for 1898 is quite low, being .61 as compared with 2.57 in 1897.

The morbidity ratio of scarlatina per 10,000 in Boston from 1892 to 1898 has varied from 62.87 in 1892 to 16.77 in 1898. The table on page 5 gives the rate for each year.

CHART 4.—Ratio of Deaths from Scarlatina per 10,000 of the Living in Boston, New York, Philadelphia, Brooklyn, Chicago and St. Louis, from 1893 to 1897.

Boston▬▬. New York——. Philadelphia ---. Brooklyn═══. Chicago.....St. Louis — —.

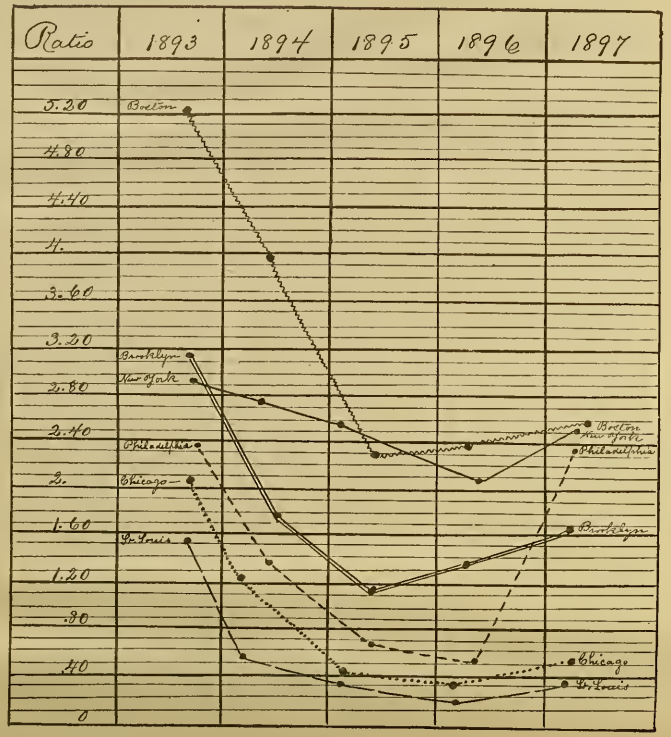


CHART 3.—Ratio of Deaths from Scarlatina per 10,000 of the Living in Boston, London, Liverpool, Glasgow, Paris and Berlin, from 1893 to 1897.

Boston▬▬. London ——. Liverpool ----. Glasgow═══. Paris ..... Berlin — —.

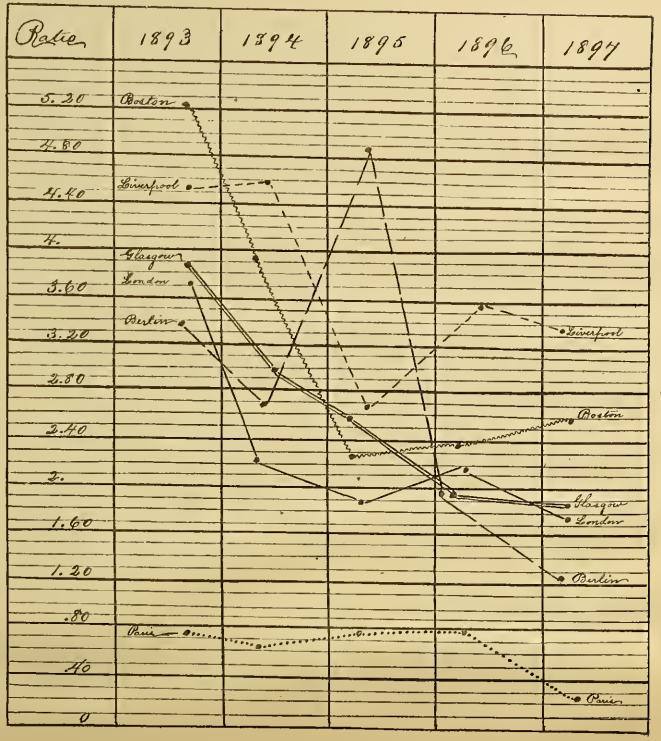


Table of the Ratio of Morbidity in Scarlatina per 10,000 in Boston, from 1892-1898, inclusive.

Years.	Rate per 10,000.	Years.	Rate per 10,000.
1892.....	62.87	1896.....	23.55
1893.....	54.09	1897.....	36.64
1894.....	45.80	1898.....	16.77
1895.....	32.11		

It will be seen from this table that there has been a decided diminution in the ratios in the last four years as compared with the first three years. This decrease is most marked in 1898, and is explained by the fact, as a careful examination of the health reports shows, that more cases were treated in the hospital than in any of the previous years.

Chart 5 shows the number of cases of scarlatina, by months, reported to the Board of Health of Boston, from January 1, 1893, to December 31, 1898. It will be seen from this chart that since 1896, each month, with the exception of March, April and May of 1897, there has been a very marked reduction in the number of cases. This reduction is particularly noticeable in 1898, and is a sufficient argument to prove the beneficial effect of hospital isolation in diminishing the frequency of the disease.

Chart 6 shows the number of deaths from scarlatina in Boston, by months, from 1893 to 1898, inclusive. It will be seen from this chart that since 1896, when the hospital was in full operation, the number of deaths each month is very considerably lower than during any of the previous months with the exception of April, May and June of 1897, when there was quite an epidemic of scarlatina in Boston. This epidemic was very speedily under control, owing to the fact that hospital accommodations were sufficient. A study of the health reports for a series of years shows conclusively that outbreaks of scarlet fever before the establishment of the South Department were not as effectively controlled. It must be borne in mind that Charts 5 and 6 give the number of cases and the number of deaths, and not the ratios,

CHART 6. — Number of Deaths from Scarlatina, by Months, reported to the Board of Health from January 1, 1893, to December 31, 1898.

1893 ~~~~. 1894 ——. 1895 - - - -. 1896 ═══. 1897 ..... 1898 — —.

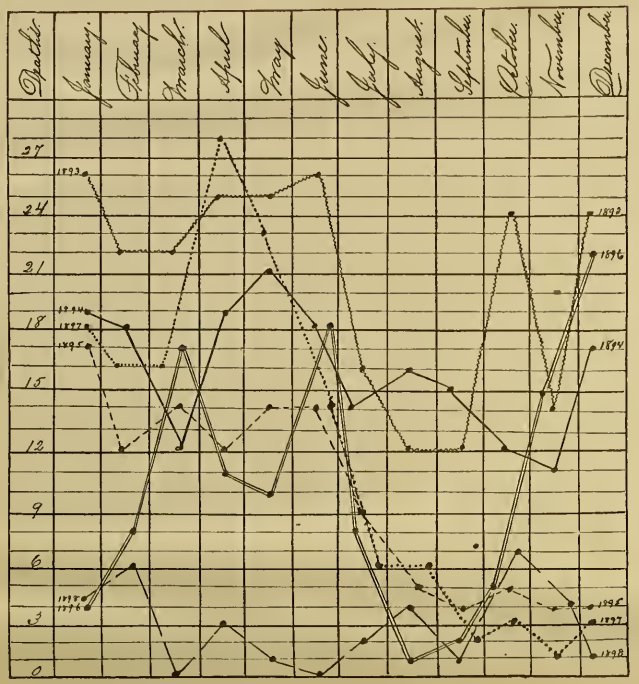
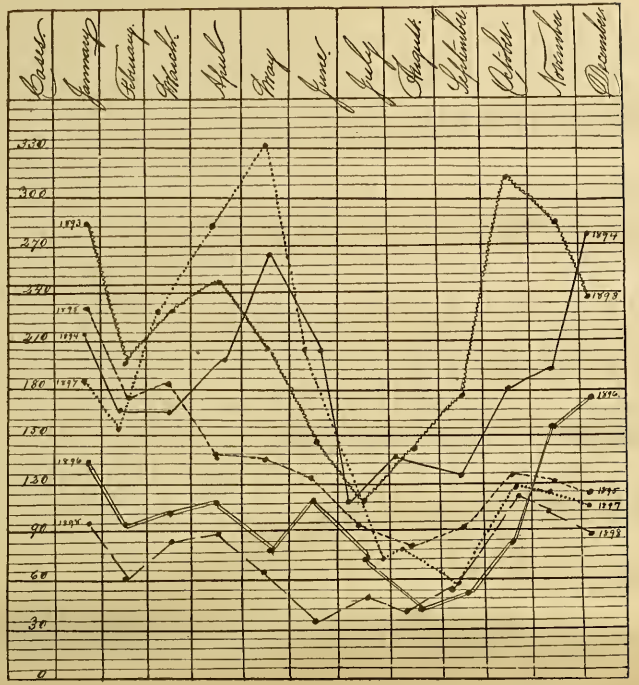


CHART 5. — Number of Cases of Scarlatina, by Months, reported to the Board of Health from January 1, 1893, to December 31, 1898.

1893 ▲▲▲▲. 1894 ——. 1895 - - - -. 1896 ═══. 1897 ..... 1898 — —.



therefore, as the population of Boston has increased from 476,945 in 1893 to 541,827 in 1898, the diminution is very much more marked than appears on the charts. This is only another argument in favor of isolation hospitals.

In an analysis of one thousand cases of scarlet fever treated at the South Department, it was found that the percentage of mortality, including moribund cases, was 9.8. The following short histories of the fatal cases and the results of the autopsies are of interest as illustrating that deaths from scarlet fever are more frequently due to some complication than to the virulence of the scarlatinal poison:

Case 1. — A boy, seven years old. He was moribund at time of entrance and lived only twenty-four hours. Temperature 105°. Very brilliant eruption. There were no complications. The boy had been ill one day at time of entrance.

Case 2. — A girl, eight years old. She was in a moribund condition when admitted, with a temperature of 106°. The patient lived for about eighteen hours. No complications.

Case 3. — A girl, ten years old. Very brilliant eruption. Constant vomiting. Baths had only a temporary effect on the temperature. The patient died in forty-eight hours after admission. There was nearly complete suppression of urine. A specimen could not be obtained for examination.

Case 4. — A girl, four years old. Had been ill four days; temperature 106°. There was a very bright eruption over the entire body; the throat was very much congested; no membrane. The patient lived two days, but was unconscious all the time. Neither the sponge bath, nor the fan bath had any effect in reducing the temperature.

Case 5. — A boy, three years old. No history could be obtained. The child had evidently been ill for some three days. The eruption was of that peculiar fiery hue seen in fatal cases of scarlet fever. Temperature 106°. The patient died in eighteen hours.

Case 6. — A girl, five years old. The patient did not have a very high temperature when admitted. The amount of albumin in the urine was quite large for the earlier stages of scarlet fever being one-eighth of one per cent. The temperature was not specially elevated, being only 103° at the time of entrance. The condition of the patient was satisfactory until twelve hours before death, when she had a convulsion, uremic in its nature, from which she did not rally. The result in this case emphasizes the importance of a guarded prognosis in the moderately severe cases of scarlet fever characterized by a large amount of albumin in the urine.

Case 7. — A boy, two years old. He had been ill three days when admitted. The eruption was of that extremely bright hue seen in severe cases; the temperature was very high, being 106°. The patient lived six days during which time the eruption did not fade in the least. Death in this case was due to the virulence of the poison of scarlet fever. There were no complications.

Case 8. — A boy, eight years of age. The rash was not very brilliant in this case; neither was the temperature specially elevated. Twenty-eight days after entrance the boy commenced to have albumin in the urine. The quantity varied from one-fourth of one per cent. to a trace. He had frequent vomiting, twitching of muscles, partial suppression of urine, and finally died in an uremic convulsion; his case is of particular interest, from the late appearance of the renal complications. Digitalis and pilocarpin were the chief drugs used. Hot packs were given frequently in the later stages of the attack.

Case 9. — A boy, twelve years old, with an eruption that was not particularly brilliant, but was general and characteristic. The throat symptoms were not very marked, although there was a small area of streptococcus membrane on each tonsil. The temperature was 106°, but this elevation was due not so much to the attack of scarlet fever as to a pneumonic process, which invaded each lung. The patient died the second day after admission. The death in this case must be attributed to pneumonia, and not to scarlet fever.

Case 10. — A boy, two years of age. He had a profuse typical eruption of scarlet fever, and he also had a very extensive diphtheritic membrane on the tonsils and uvula. Death supervened in two days; the cause being diphtheria, and not scarlet fever.

Case 11. — A girl, seven years old. On entrance the patient had a temperature of 104°, a brilliant rash on the body, and a streptococcus membrane in the throat. There was one-fourth of one per cent. of albumin found in the urine, and many casts. The temperature remained elevated, baths having no effect on it. Delirium was a marked symptom in this case. Death occurred on the twelfth day of the disease, being caused by acute desquamative nephritis.

Case 12. — A girl, three years old. The eruption of scarlet fever, although very general, was not particularly brilliant. The diphtheritic membrane, however, was very extensive. The temperature was not specially elevated. The manner of death pointed to diphtheria as the cause, although scarlet fever may have been a factor in contributing to the fatal issue.

Case 13. — A boy, two years old. This patient had a brilliant eruption on the body, and diphtheritic membrane on the tonsils. The course of the disease progressed favorably for twelve days. A broncho-pneumonia, however, developed on the thirteenth, which caused the patient's death in three days.

Case 14. — A girl, eight years of age. She had been ill two days. There was a very brilliant eruption of scarlet fever on the body, and a somewhat extensive diphtheritic membrane in the throat. The patient only lived sixteen hours after entrance. Scarlet fever seemed to be the most important factor in causing the death of this patient, although the diphtheritic process may have had a certain deleterious influence.

Case 15. — A boy, four years of age. When admitted he had been intubed for laryngeal stenosis, and was in a very fair condition so far as diphtheria was concerned. The eruption of scarlet fever was not particularly brilliant, neither was the temperature specially elevated. The patient did well for three days when he suddenly died from cardiac failure, due to the toxin of diphtheria. Scarlet fever could not be considered as being the cause of death in this case.

Case 16. — A girl, five years of age. When admitted she had a characteristic eruption of scarlet fever, and a slight amount of diphtheritic membrane on the tonsils. Three days after admission the patient developed laryngeal stenosis, and was intubed. She did well for three days, but finally died from extension of the membrane into the bronchi.

Case 17. — A boy, two years of age. This patient had a moderately severe attack of scarlet fever, and for the first four days did well. On the fifth day, however, he had an attack of broncho-pneumonia, from which he succumbed in three days. Scarlet fever was not directly the cause of death in this case, but there is no doubt that the broncho-pneumonia was aggravated by his condition.

Case 18. — A boy, seven years of age. He had been ill twenty-four hours. There was marked delirium, a very brilliant eruption, and a very high temperature. He lived for six days after admission, although he was comatose for the last forty-eight hours of the illness. This was a death due directly to scarlet fever.

Case 19. — A boy, three years of age. At time of entrance he had a well-marked eruption of scarlet fever, and a very high temperature. Baths lowered the temperature only for a short time. There was an extensive streptococcus membrane in the throat. Death which occurred four days after entrance must be attributed to scarlet fever, as there were no complications.

Case 20. — A girl, three years old. This patient had a characteristic eruption, a high temperature, and a marked congestion of the throat, but no membrane. This was a case of the fulminating variety of scarlet fever. The patient died six days after admission. Scarlet fever must be considered the cause of death, as there were no complications.

Case 21. — A boy, six years of age. This patient had diphtheria as well as scarlet fever. The attack of scarlet fever, however, was comparatively mild, and could in no way have contributed to his

death. Death was undoubtedly due to cardiac failure, the direct and immediate result of the absorption of the toxin of diphtheria.

Case 22. — A girl, nineteen years of age. This patient when admitted had a temperature of 104°, and had a very brilliant and characteristic eruption of scarlet fever. The throat symptoms were not particularly marked. Baths reduced the temperature materially. On the fifth day after entrance the temperature became normal. On the twelfth day after the temperature reached the normal line, and the seventeenth day after admission the urine commenced to diminish in quantity; there was more or less nausea and vomiting, and a certain suspicious twitching of the muscles. The symptoms indicative of uremia continued to increase in severity, and the patient died in about ten days from the commencement of the attack of nephritis. The amount of albumin in the urine varied from one-fourth to one-eighth of one per cent.

Case 23. — A girl, six years of age. The patient had been ill three days when admitted. She had a high temperature, a characteristic eruption of scarlet fever over the entire body, and large areas of diphtheritic membrane on the tonsils. There was marked prostration. The patient died the fourth day after admission, apparently of diphtheria. The attack of scarlet fever could not have played an important rôle in contributing to the fatal issue.

Case 24. A boy, three years of age, was admitted the fourth day of his illness, suffering from scarlet fever and diphtheria. The temperature in this case remained persistently high during the whole course of the disease. He died in ten days from diphtheria and scarlet fever.

Case 25. — A girl, three years of age, had been ill one week at the time of admission. She had a well-marked eruption of scarlet fever and a characteristic diphtheritic membrane in her throat. As is frequently the case in diphtheria associated with scarlet fever, antitoxin seemed to have no effect. Fifteen days after admission the patient developed a broncho-pneumonia, which was probably the immediate cause of death. This could not be considered a death from scarlet fever, as the clinical history of the case and the manner of dying point to broncho-pneumonia induced by the attack of diphtheria as the cause of death.

Case 26. — A boy, two years of age. This patient was admitted in a moribund condition; he had a temperature of 104°, a typical eruption of scarlet fever over the entire body, and a thick dirty gangrenous membrane on each tonsil. All treatment was unavailing, and he died in twenty-four hours after admission. In this case it would seem that scarlet fever and diphtheria were equally responsible for the death.

Case 27. — A boy, two years of age. This patient when admitted had marked enlargement of the papillæ of the tongue and small

areas of a white membrane, probably due to streptococci. The temperature remained persistently elevated, and the patient was unconscious. He died seven days after admission. From the characteristic elevation of the papillæ of the tongue, from the appearance of the throat, from the dry and papery feel of the skin of the body, from the dry and horny feel of the hands and feet and from the persistently high temperature, it is evident that this was a case of scarlatina *sine eruptione*.

Case 28. — A girl, two years of age. This patient when admitted had diphtheritic membrane in the fauces, elevated papillæ of the tongue, a fine punctate eruption on the body, and a temperature of 103°. She was semi-conscious, and died in five days after admission. Scarlet fever and diphtheria were equally responsible for the death.

Case 29. — A girl, two years of age. This patient had a typical eruption of scarlet fever on the body, and marked elevation of the papillæ of the tongue. Four days after admission she had suffusion of the eyes, and careful examination behind the ears detected a commencing papular eruption of measles. On the fifth day after the appearance of the eruption of measles she developed a broncho-pneumonia and died in forty-eight hours. Death in this case must be attributed to broncho-pneumonia induced by the attack of measles. Scarlet fever cannot be considered an important factor.

Case 30. — A boy, three years of age, on admission, was found to have diphtheritic membrane in the throat, elevation of the papillæ of the tongue, fine punctate eruption on the body and a temperature of 104°. He lived for six days. The clinical history of the case and the mode of death point to scarlet fever as the cause, rather than to diphtheria.

Case 31. — A boy, two years of age. This patient when admitted had been ill one day. He had a characteristic eruption of scarlet fever. The temperature was not specially elevated, and on the fourth day reached the normal line. On the seventh day after admission there was a sudden rise in temperature, suppression of urine and edema of the face. On the thirteenth day after admission the patient died. The history of this case emphasizes the importance of giving a doubtful prognosis in even the mildest case of scarlet fever; for there was nothing in the condition of the patient on the first four days of his illness to indicate any renal complication. As is sometimes the case the kidneys after having performed their functions properly during the initial stage of the disease suddenly cease to act, and the patient dies from uremia.

Case 32. — A girl, two years of age. This patient was admitted with a characteristic eruption of scarlet fever, not particularly brilliant, and not a specially high temperature. On the sixth day after admission she developed an eruption of measles, and three days later had an attack of broncho-phneumonia. She died in three days after

the onset of the lung complication. At the autopsy acute nephritis, acute splenitis, acute broncho-pneumonia, and acute lymphatic hyperplasia were found.

Case 33. — A boy, two years of age. This patient was admitted with the characteristic symptoms of scarlet fever. There was a very profuse nasal discharge, cultures from which showed the presence of streptococci. There was a peculiar septic odor, which is not infrequently detected in cases of scarlet fever, characterized by a profuse nasal discharge. This so-called septic odor must be distinguished from a somewhat similar odor noticed in diphtheria. The boy lived twelve days. At the autopsy broncho-pneumonia and hyperplasia of the mesentery glands were found.

Case 34. — A boy, three years of age, was admitted with the usual symptoms of scarlet fever. Four days later he developed an eruption of measles, and ten days later developed a broncho-pneumonia, from which he succumbed. It is interesting to note that the attack of scarlet fever ran a benign course for four days, or until the onset of the attack of measles.

Case 35. — A boy, nine years of age. This patient on admission had a high temperature, and an extremely brilliant eruption. He was wildly delirious, and lived only twenty hours. At the autopsy broncho-pneumonia and general lymphatic hyperplasia were found. The spleen was very considerably enlarged. Cultures from the larynx revealed the presence of the staphylococcus pyogenes aureus and albus. There was a diffuse growth of the colon bacillus in cultures from the kidneys. As this patient had been ill only two days the case can be classed as one of the fulminating variety of scarlet fever.

Case 36. — A boy, six years of age, was admitted on the second day of an attack of scarlet fever. The case progressed fairly well for seven days, when there was a sudden rise in temperature, and a suppression of urine. Hot packs and subcutaneous injections of pilocarpin were given. These remedial measures seemed to have a beneficial effect for a short time, but the relief was only temporary, and the patient finally died in six days after the commencement of the renal complication. The condition of the kidneys was the immediate cause of death.

Case 37. — A boy, three years of age. This patient had a very high temperature at entrance and an extremely brilliant eruption. He also had a profuse nasal discharge. The urine contained a large trace of albumin. Milk packs and cold packs did not have any appreciable effect on the temperature; on the eighth day the heart sounds were somewhat feeble, and a faint pericardial friction sound could be detected. The area of cardiac dulness was not increased to a marked degree. Death supervened the seventeenth day after admission. Lymphoid infiltration of the kidneys, pericardial effusion,

dilatation of the left ventricle of the heart, edema of the lungs, chronic passive congestion of the lungs, liver and spleen and acute hyperplasia of the abdominal lymphatics were found at the autopsy.

Case 38.— A boy, three years of age, was admitted with a characteristic eruption of scarlet fever and a temperature of 101°. The case progressed favorably for six days when there was a sudden elevation of temperature. An examination of the chest detected bronchial breathing and crepitant and sub-crepitant râles in each lung. The boy died six days after admission. At the autopsy extensive bronchitis and broncho-pneumonia were found. There was acute hyperplasia of the mesenteric lymph glands.

Case 39. — A boy, one year old. When he was admitted he was in the initial stage of measles and in the desquamative stage of scarlet fever. In four days he developed a broncho-pneumonia of the right lung, and a pneumonia of the left lung. In three days from the commencement of the attack of pneumonia he died. At the autopsy acute fibrinous pneumonia of the left lung and a broncho-pneumonia of the right lung were found. Death in this case could not be considered as caused by scarlet fever. There is no doubt, however, that the attack of measles was rendered much more severe by the scarlatinal process.

Case 40. — A girl, seven years of age. When she was admitted she had a very brilliant eruption of scarlet fever and an exceedingly high temperature. Examiuation of the urine showed one-fourth of one per cent. of albumin, epithelial and granular casts. The patient lived five days, and during this time was delirious. The eruption did not fade in the slightest degree. The area of cardiac dulness was somewhat increased. At the autopsy congestion and edema of the lungs, pericardial effusion and acute enlargement of the spleen were found. Death in this case was due to scarlet fever with complications.

Case 41. — A boy, six years of age, was admitted iu the acute stage of scarlet fever. The rash was extremely brilliant, the temperature was 104°. There was marked prostration, a strong septic odor, profuse nasal discharge and great enlargement of the cervical glands. Death ensued in twenty-four hours. No autopsy. Death was evidently due to scarlet fever, without complications.

Case 42. — A boy, five years of age. The eruption in this case was not particularly brilliant, neither was the temperature specially elevated. The area of cardiac dulness was slightly increased. The action of the heart was irregular, and the first sound reduplicated. In the lungs there were small areas of dulness and mucous and submucous râles could be heard. At the autopsy dilatation of the left ventricle of the heart, congestion of the lungs and broncho-pneumonia were found.

Case 43. — A girl, four years of age. When this patient was admitted she had an eruption of scarlet fever and also a diphtheritic

membrane in the throat. The case progressed favorably for five days, when the girl developed symptoms of laryngeal stenosis, and was intubed with marked relief. She died, however, on the thirty-fifth day of her illness from renal complications.

Case 44. — A boy, sixteen months old, was admitted with a characteristic eruption of scarlet fever and a diphtheritic membrane on the tonsils. He did well for ten days, when suddenly he had an attack of laryngeal stenosis, which was relieved by intubation. The patient, however, died in two days, apparently from cardiac failure. The autopsy revealed acute diphtheritic pharyngitis, acute broncho-pneumonia of each lung, acute general lymphatic hyperplasia, acute splenitis, acute parenchymatous degeneration of liver and kidneys and acute congestion of the spleen.

Case 45. — A boy, ten months old, was admitted, with a characteristic eruption of scarlet fever and a temperature of 102°. On the fourth day after entrance he developed laryngeal stenosis, for which he was intubed with marked relief. The patient, however, died on the thirteenth day of the illness. Acute diphtheritic pharyngitis, acute broncho-pneumonia of the middle lobe of the right lung, acute splenitis, and acute edema of the brain were found at the autopsy. Death in this case could not be considered as due to scarlet fever.

Case 46. — A girl, three years old. When this patient was admitted she had a well marked eruption of scarlet fever and a temperature of 100°. On the third day, however, the temperature rose to 104°. In this case there was also a profuse diarrhea, which is always a very grave symptom in scarlet fever. She died the fifth day after admission, and the seventh day of the disease. In this case the eruption did not fade, neither did the temperature drop to any appreciable extent. No autopsy. Death in this case was due to scarlet fever without complications.

Case 47. — A girl, two years of age, was admitted with a history of an illness of one day. She had two convulsions before entrance and several after. The rash was not particularly well pronounced, but the temperature was exceedingly high. No complications could be detected. She lived two days. An acute general lymphatic hyperplasia, an acute splenitis, a slight edema of the brain, acute parenchymatous degeneration of liver and kidneys were found at the autopsy.

Case 48. — A girl, eleven years of age, was admitted with the usual symptoms of scarlet fever of not a very severe type. The area of cardiac dulness was not increased, the action of the heart was regular. A loud blowing systolic murmur was detected. For the first three weeks the course of the disease progressed favorably. The eruption faded, and the temperature became normal. On the twenty-third day after admission and on the twenty-fifth day of the illness, when the patient was apparently convalescing, suddenly she

was taken with nausea and vomiting, and complained of severe pain in the back of the head. The urine previous to this time had been normal in amount, and contained only a very slight trace of albumin. An examination of the urine, however, shortly after the girl vomited, showed an increase in the amount of albumin. On the twenty-sixth day there was suppression of urine, and the patient had a convulsion. Pilocarpin and nitro-glycerin seemed to give relief, and on the twenty-seventh day the condition of the patient was fairly satisfactory. She became conscious, and took nourishment quite well. On the thirtieth day the child became somewhat stupid, and she had a slight convulsion. On the fifty-eighth day of the illness and the thirty-second day after the first convulsion, the patient had a series of convulsions from which she did not rally, but gradually sank and died in twenty-four hours. At the autopsy acute broncho-pneumonia of the right lung, acute interstitial nephritis, acute softening of the brain, hypertrophy of the left ventricle of the heart, hemorrhagic endocarditis, acute general lymphatic hyperplasia and a slight arterio-sclerosis were found. This could hardly be called a death from scarlet fever, as is shown by the result of the autopsy.

Case 49. — A girl, fourteen months old. This patient had a very brilliant rash and a high temperature. She succumbed to the disease three days after entrance. This can be considered a death from scarlet fever.

Case 50. — A boy, four years of age, was admitted with the characteristic eruption of scarlet fever, a high temperature and elevated papillæ of the tongue. On each tonsil was a patch of membrane of a pearly whiteness. The culture showed the presence of streptococci. There was considerable enlargement of the cervical glands. The patient died on the twelfth day after admission, and the fifteenth day of the illness. At the autopsy suppurative cervical adenitis, acute splenitis, acute suppurative inflammation of the middle ears, slight edema of the brain and acute interstitial nephritis were found. This must be considered a death from scarlet fever without complications.

Case 51. — A boy, ten years of age. The patient had been ill twenty-four hours. When admitted there was marked prostration, enlargement of the cervical glands, a profuse nasal discharge, a very brilliant eruption of scarlet fever and a high temperature. The boy was wildly delirious. Sponge baths, of which he had twenty-two, had only a slight temporary effect on the temperature. The only specimens of urine that it was possible to obtain were free from albumin. On the seventh day after after admission, and the ninth day of the illness, the patient had a convulsion and died in about an hour. This was evidently a death from scarlet fever, as there were no complications.

Case 52. — A boy, four years of age, was admitted with the usual symptoms of scarlet fever. The temperature was 104°, and neither

milk packs, nor sponge baths had any marked influence in reducing it. The patient died the seventh day after admission, and the ninth day of the disease. There were no convulsions. At the autopsy hypostatic congestion of the lungs, sub-plural ecchymosis and general lymphatic hyperplasia were found. Death in this case was clearly due to scarlet fever.

Case 53. — A girl, four years of age, was admitted in a state of extreme prostration, with the characteristic eruption of scarlet fever and a temperature of 105°. The condition of the patient was hopeless from the very first. She died on the seventh day after admission, without developing any special symptoms. As there were no complications, scarlet fever must be responsible for the death.

Case 54. — A girl, three years of age. This patient, when admitted, had scarlet fever and diphtheria. She died on the thirtieth day after admission. A broncho-pneumonia developed about ten days before death. The kidneys did not seem to be specially implicated, as there was only a slight trace of albumin found in the urine. Broncho-pneumonia, from a clinical point of view, must be considered as the immediate cause of death. No autopsy.

Case 55. — A girl, five years of age, was admitted with diphtheritic membrane in the throat, a very brilliant eruption and a temperature of 105°. She was extremely delirious at times. She died thirteen days after admission. The urine contained a slight trace of albumin. At the autopsy ulceration of the œsophagus, general acute lymphatic hyperplasia and acute splenitis were found. It is interesting to note that in the culture from the heart streptococci were found, and also in the cultures from the liver, spleen and kidneys. There was an abundant growth of the bacilli of diphtheria in the cultures taken from the œsophagus. It would seem as if the streptococcus infection was the most important factor in causing the death of this patient.

Case 56. — A man, twenty-four years of age, was admitted in a moribund condition. He had a very weak, irregular and compressible pulse. The heart sounds were very indistinct. On the body was a characteristic eruption of scarlet fever. The urine was smoky in color, and contained one-tenth of one per cent. of albumin. Blood and pus were found in the sediment. The patient was wildly delirious, and died twenty-eight hours after admission. Scarlet fever, without complications, must be considered the cause of death in this case.

Case 57. — A boy, two years old. This patient was admitted in a state of marked prostration. The eruption was characteristic, but the temperature was not specially elevated. He lived two days, but his condition was hopeless from the first. Scarlet fever of a virulent type was the cause of death.

Case 58. — A boy, three years of age. When admitted had the characteristic eruption of scarlet fever and a temperature of 104°.

There was a profuse nasal discharge and every indication of a streptococcus infection. Death occurred on the tenth day after admission, and the eleventh day of the illness. At the autopsy anasarca, cloudy swelling of the kidneys and fatty degeneration of the liver were found. Death in this case can with reason be attributed to the condition of the kidneys.

Case 59. — A boy, two years of age. This patient had a tube in the larynx when admitted. He was suffering from diphtheria and scarlet fever. Four days after entrance a broncho-pneumonia developed. He died on the eleventh day after entrance. At the autopsy a diphtheritic laryngitis, a broncho-pneumonia of the right lung, cloudy swelling of the kidneys, acute lymphatic hyperplasia and acute splenitis were found. The clinical history of this case would point to a death from diphtheria rather than one from scarlet fever, as the scarlatinal process was not particularly severe. The cloudy swelling of the kidneys could be explained by the action of the toxin of diphtheria.

Case 60. — A girl, two years of age, was admitted with a fading eruption of scarlet fever, a slight patch of diphtheritic membrane on each tonsil and a septic odor. The temperature was 104°. She also had pneumonia of the entire left lung with a commencing pneumonic process in the lower lobe of the right lung. The patient died in four days. This must be considered as a death from pneumonia, occurring as a complication in diphtheria. It is doubtful if the scarlatinal process was either directly or indirectly the cause of death.

Case 61. — A boy, four years of age, was admitted with a very brilliant eruption of scarlet fever and an extremely high temperature. He gradually grew worse, and died on the tenth day after admission. This was a death from scarlet fever. No complications were detected.

Case 62. — A child, two years of age. This patient when admitted had diphtheria and scarlet fever. She also had a very extensive broncho-pneumonia of the right lung. Death in this case cannot be attributed to scarlet fever, but must be considered as due to diphtheria and the complication of broncho-pneumonia.

Case 63. — A woman, twenty-one years of age. When admitted there was a very brilliant eruption of scarlet fever and a temperature of 102°. The urine contained a very slight trace of albumin. On the twenty-sixth day after entrance the patient complained of headache, and had frequent attacks of vomiting. The urine was smoky in color, and had a specific gravity of 1011. There was a large trace of albumin found. On the next day she had several convulsions, and died on the twenty-eighth day after entrance. The late onset of the renal complications is somewhat unusual in scarlet fever. The cause of death in this case must be considered as due to scarlatinal nephritis.

Case 64. — A girl, seven years of age. This patient when admitted had a temperature of 105° and an extremely brilliant eruption of scarlet fever. There was a very rapid irregular and weak pulse. The heart sounds were very faint. She died in forty-eight hours, having been extremely delirious all the time. As there were no complications scarlet fever must be considered the cause of death.

Case 65. — A boy, three years old. He had been ill one week. When admitted he had a temperature of 103° which during the following five days reached 105°. The urine contained a slight trace of albumin. Delirium was a marked symptom in this case. The patient died the fifth day after entrance, and on the twelfth day of the disease. The cause of death was scarlet fever.

Case 66. — A boy, eighteen months old. He had been ill one day. The eruption was characteristic. He had a profuse nasal discharge, cultures from which showed the presence of the bacilli of diphtheria. He died on the twenty-second day of the illness. In this case the presence of a profuse nasal discharge containing bacilli of diphtheria would point to nasal diphtheria as an important factor in contributing to the fatal issue.

Case 67. — A girl, three years of age, was admitted with scarlet fever and diphtheria. She did well for some little time when suddenly there appeared suffusion of the eyes and the characteristic cough of measles. On the following day the eruption appeared. She had pneumonia, and later developed an inflammation of the mastoid cells, on the right side. The patient had a second attack of pneumonia, and finally died. At the autopsy organization of the right lung after pneumonia, acute general lymphatic hyperplasia, acute splenitis, "operation wound" of right mastoid, purulent inflammation of the left middle ear, edema and congestion of the brain and its membranes were found. This cannot be considered a death from scarlet fever.

Case 68. — A boy, five years of age, was admitted with diphtheria and scarlet fever. The scarlatinal process was not specially severe, but the diphtheritic process was quite extensive. He lived for two days. At the autopsy acute diphtheritic tonsillitis, acute purulent rhinitis, acute general lymphatic hyperplasia, chronic tuberculosis of the mesentery glands, cloudy swelling of the kidneys and acute splenitis were found. This should be considered a death from diphtheria, rather than one from scarlet fever.

Case 69. — A boy, two years of age, was admitted with scarlet fever and diphtheria. The eruption was very brilliant, the temperature 103°, and there was a characteristic diphtheritic membrane on each tonsil. For the first fourteen days the patient did well, on the fifteenth day he had a profuse nasal discharge, and there was a strong septic odor. He had attacks of epistaxis at frequent intervals, and also hemorrhages from the ear, mouth, urethra and rectum. Spots

of ecchymosis appeared upon the body and legs. The patient died on the twenty-fifth day from the commencement of the illness. Scarlet fever could not have caused his death, which must be attributed to the streptococcus infection following and dependent on the diphtheritic infection. Death from this cause was extremely common in diphtheria before the days of antitoxin.

Case 70. — A girl, ten years of age, was admitted in a moribund condition. She had been ill for three days before entrance. The eruption in places was perfectly characteristic of scarlet fever. There were many small hemorrhagic areas on the body. The patient died in forty-eight hours. This must be considered a case of hemorrhagic scarlet fever.

Case 71. — A girl, six years of age, had been ill one day with vomiting, sore throat and convulsions. When admitted the lips were blue, the hands and the feet were cold. The pulse was irregular and weak; the temperature was 103°. On the body was an eruption of scarlet fever, and also numerous hemorrhagic areas. Just before death, which occurred in about twenty hours after admission, the temperature rose to 106°. There was complete suppression of urine. Hemorrhagic scarlet fever was the cause of death.

Case 72. — A boy, three years of age, was admitted with the characteristic symptoms of scarlet fever and diphtheria. The prognosis from the first was hopeless. He had double otitis media and suppurating cervical glands. He lived for twenty-five days. At the autopsy double otitis media, diphtheritic rhinitis, suppuration of the glands of the neck and an abscess of the spleen were found. In cultures from the heart, from the liver, and from the abscess of the spleen streptococci were found. Streptococcus infection, induced by the scarlet fever process, was the probable cause of death.

Case 73. — A girl, three years of age, was admitted with scarlet fever and diphtheria. She lived for four days. On the evening of the third day the temperature reached 106°. She was extremely delirious. From the limited amount of membrane seen, from the extreme delirium and from the high temperature it is safe to conclude that scarlet fever was the cause of death and not diphtheria.

Case 74. — A boy, three years old. When the patient was admitted he had been ill two days. He had a very rapid pulse; there was diphtheritic membrane on each tonsil, a characteristic eruption of scarlet fever on the body, and a pneumonia of the upper and middle lobes of the right lung. On the fifth day after entrance the cervical glands commenced to enlarge, and there was an extensive cellulitis of the neck and chest. The urine was diminished in quantity and contained a large trace of albumin. On the twelfth day after entrance, and the fourteenth day of the illness, the patient died. The cause of death in this case was probably pneumonia and the extensive cellulitis. The diphtheritic process was not extensive enough to be considered a factor in causing the death.

Case 75. — A boy, thirteen years of age. When admitted this patient had been ill twenty-four hours. There was marked prostration and extreme delirium. A streptococcus membrane covered each tonsil. At the apex of the heart was heard a well-marked systolic murmur which was transmitted. The boy died in twenty-four hours after admission. At the autopsy acute tonsillitis, pharyngitis, small multiple abscesses of the œsophagus, acute splenitis, chronic adhesive pleurisy, congestion of the lungs, cloudy swelling of the liver and kidneys were found. Cultures from the tonsils and from the lungs revealed streptococci and staphylococci. Scarlet fever was evidently the cause of death.

Case 76. — A girl, seven years of age, was admitted on the second day of her illness. There was swelling of the cervical glands, marked prostration and slight delirium. The throat was intensely congested, but no membrane could be seen. The eruption was characteristic and quite brilliant. The temperature was 105°. The patient lived about twenty hours. At the autopsy, acute splenic tumor, acute congestion of lungs, liver and kidneys, general lymphatic hyperplasia and cervical adenitis were found. Cultures from the heart, lungs and kidneys revealed the presence of streptococci. This case would seem to show that the streptococcus infection plays an important rôle in deaths from scarlet fever.

Case. 77. — A girl, six years of age, was admitted the third day of her illness. She had a characteristic eruption of scarlet fever and a temperature of 103°. On the sixth day after entrance a bronchopneumonia of each lung developed. On the seventh day the area of the heart was found to extend from one-quarter of an inch to the right of the sternum, to about one-half an inch outside the nipple line; the apex was in the sixth interspace. A *bruit de galop* was heard all over the pre-cordial area; at the apex could be heard a loud blowing systolic murmur that was transmitted to the axilla; at the base the pulmonic second sound was markedly accentuated. The next few days the heart dilated to a very considerable extent. On the twenty-third day after entrance a distinct pericardial friction sound was detected. The urine contained albumin in varying amounts during the whole course of the disease; the urea was diminished in a marked degree. The patient died on the thirty-first day of the illness. Acute fibrinous pericarditis, acute aortic endocarditis, acute general lymphatic hyperplasia, acute splenitis, cloudy swelling of the liver and kidneys, and acute otitis media of left ear were revealed at the autopsy. Frozen sections of the heart and kidney showed no fatty degeneration. The condition of the heart in this case is comparatively rare in scarlet fever, but it does occur even in the mildest attacks of the disease.

Case 78. — A woman, twenty-seven years of age. This patient was admitted on the second day of the illness. The eruption was

characteristic, temperature was 103°. There was marked prostration, persistent vomiting. The woman died twenty-four hours after entrance. An acute splenic tumor, hyperplastic lymph glands and tonsils were revealed at the autopsy. Cultures from the heart gave almost a pure growth of streptococci. In cultures from the kidneys streptococci and colon bacilli were found. This would seem to be another instance in which the streptococcus infection is an important factor in causing death during an attack of scarlet fever.

Case 79. — A girl, two and one-half years of age, was admitted on the sixth day of her illness. The eruption was not particularly brilliant, neither was the temperature specially elevated. No membrane could be seen in the throat. Twenty-four hours after admission there was marked dyspnea, which was relieved by intubation. The tube was removed in three days, but it was necessary to re-introduce it at the end of four days. Extensive areas of broncho-pneumonia appeared on the seventh day after entrance. The patient died on the eighteenth day of her illness. No autopsy. The scarlatinal process in this case was not sufficiently severe to have had a marked influence in causing death, but the fatal issue must be attributed to broncho-pneumonia following a diphtheritic process in the larynx.

Case 80. — A girl, two years of age. This patient was in a hopeless condition when admitted. She had a temperature of 105°, with an eruption of a particularly dusky hue. She died in twenty-four hours after entrance. This must be considered a death from scarlet fever.

Case 81. — A girl, five years of age, admitted on the third day of her illness. She had a temperature of 101°, marked prostration, a very brilliant eruption, with hemorrhagic areas in the groins and posterior portions of the thighs. At time of admission the heart was slightly dilated, but in three days this dilatation had considerably increased. The patient died on the twenty-first day of the illness. At the autopsy, acute general lymphatic hyperplasia, chronic tuberculosis of the mesentery glands, and dilatation of the left side of the heart were found. Frozen sections of the heart muscle and kidney showed fatty degeneration, more marked in the kidneys.

Case 82. — A girl, three years of age, was admitted with diphtheria and scarlet fever, having been ill about five days. There was a profuse nasal discharge, and a strong septic odor. The urine contained a slight trace of albumin. The cervical glands were enlarged and tender to the touch. The patient seemed to improve for nine days, at the end of which time there was persistent vomiting and marked collapse. She died on the fifteenth day of her illness. Cardiac failure, due to the toxin of diphtheria, was an important factor, but the streptococcus infection was equally responsible for the death. Necrosis of the structures of the nose, abscess of the left

antrum of Highmore, abscesses of the right and left deep cervical glands, acute general lymphatic hyperplasia, acute splenitis, acute swelling of the liver and kidney were found at the autopsy. Cultures from the spleen, liver and kidneys showed abundant growths of streptococci.

Case 83. — A boy, two and one-half years of age, was admitted the third day of his illness. He had a characteristic eruption, and a temperature of 103°. The urine contained a slight trace of albumin. On the second day after admission a broncho-pneumonia developed in the right lung. He was comatose for two days before death, which occurred on the ninth day of the illness. Acute broncho-pneumonia of the lower lobe of the right lung, acute general lymphatic hyperplasia and acute suppurative inflammation of the middle ears were found at the autopsy. Streptococci were found in cultures from the ears. The broncho-pneumonia was not sufficient in extent to have caused his death, and therefore scarlet fever must be considered the cause.

Case 84. — A girl, nineteen years of age. The patient had been ill six days when admitted. There was enlargement of the cervical glands, a septic odor and marked prostration. The throat was intensely congested, and the tonsils very much enlarged, nearly meeting in the centre. The tongue was red and cracked on the edges, and in the centre covered with a thick white coat. On the body there was a very brilliant eruption of scarlet fever. The temperature was 105°. The patient was semi-conscious. She died in twenty-four hours. At the autopsy acute general lymphatic hyperplasia, acute splenitis, sub-plural and sub-pericardial hemorrhages, fatty degeneration of the kidney, and sub-mucous hemorrhage of the stomach were found.

Case 85. — A girl, two years of age, was admitted with laryngeal diphtheria and scarlet fever. The eruption was characteristic, but not specially brilliant. She was intubed, but without relief, and tracheotomy was performed. There was marked relief after tracheotomy was done. She developed a broncho-pneumonia which was the immediate cause of death. She died on the twenty-sixth day of her illness. Scarlet fever certainly was not responsible for the death, neither was diphtheria. No autopsy.

Case 86. — A woman, twenty-one years of age, was admitted on the fourth day of her illness. There was an extremely brilliant eruption of scarlet fever, a temperature of 106°. The patient was semi-conscious. Four days previous to entrance she had been confined. The labor was normal, the child was born alive. On the next day after her confinement she had a rise in temperature, and the rash appeared. She died twenty-four hours after entrance, and the fifth day of her illness. At the autopsy acute general lymphatic hyperplasia, acute splenitis, parenchymatous degeneration of liver and

kidneys, marked fatty degeneration of heart and kidneys, acute diphtheritic endometritis and chronic tuberculosis of bronchial glands were found. This must be considered a case of scarlet fever, occurring in the puerperal state.

Case 87. — A girl, six years of age, was admitted with a temperature of 105°, an extensive eruption of scarlet fever and marked throat symptoms. She had been ill one day. There was persistent vomiting. Death occurred on the eleventh day of the illness. Empyema of each antrum of Highmore and of the sphenoidal sinus, general acute adenitis, general sub-acute petechial hemorrhages, fatty degeneration of the kidneys and edema of the lung were found at the autopsy.

Case 88. — A girl, eight years of age, was admitted with a perfectly characteristic eruption of scarlet fever and a not particularly high temperature. The patient did well for thirty days. In fact, was very nearly through desquamation when there was a rise in temperature, and every indication of some cerebral complication. The urine, which was normal in amount, contained only a slight trace of albumin. The cerebral symptoms increased in severity, and the patient died seventy-three days after admission, having been for five days before death practically unconscious. At the autopsy chronic pleurisy of right lung, edema of lungs, tuberculosis of bronchial glands and tubercular meningitis were found. Microscopic examination of stained smears made from the material in the interpeduncular space and from fluid in the left ventricle of the brain revealed fairly abundant tubercle bacilli. It is perfectly evident that scarlet fever was not the cause of death in this case.

Case 89. — A girl, three years of age, was admitted the second day of her illness with a very brilliant eruption of scarlet fever and a temperature of 103°. Two days after entrance there was a profuse nasal discharge and a strong septic odor. Cultures from the nasal discharge did not contain bacilli of diphtheria, but did contain streptococci. Persistent vomiting was a marked symptom. The patient died on the fourteenth day after admission. At the autopsy nothing very definite was found. Death in this case was due to scarlet fever without complications. It is interesting to note that nothing abnormal was found in the kidneys.

Case 90. — A boy, eighteen years of age, was admitted on the second day of his illness. There was a very brilliant eruption of scarlet fever, and a temperature of 103°. The urine contained a trace of albumin. There was violent delirium. On the sixth day after entrance an eruption of facial erysipelas appeared. The patient died on the eighth day of his illness. At the autopsy acute fibro-purulent pericarditis and embolic pneumonia, acute general lymphatic hyperplasia, erysipelas and an acute splenic tumor were found. Erysipelas was an important factor in causing the death of

this patient. The pericarditis was probably due to the scarlatinal infection.

Case 91. — A boy, five years of age, was admitted on the second day of his illness with a well-marked eruption of scarlet fever, and a patch of diphtheritic membrane on each tonsil. On the fifth day there was marked enlargement of the cervical glands and a rise in temperature. The glands suppurated. The patient died the seventeenth day after admission, and the nineteenth day of his illness. Scarlet fever was the cause of death in this case. No autopsy.

Case 92. — A boy, four years of age, was admitted the second day of his illness. The eruption was brilliant and the temperature was quite high. The cervical glands were enlarged. A culture taken from the membrane in the throat showed the presence of streptococci. The urine contained a slight trace of albumin. The patient died the fifteenth day after admission, having developed four days previous broncho-pneumonia. The autopsy revealed acute bronchitis and broncho-pneumonia, acute interstitial nephritis and general lymphatic hyperplasia. Streptococci were found in cultures from the heart and spleen. Scarlet fever was clearly responsible for this death.

Case 93. — A boy, three years of age, was admitted the fourth day after an attack of vomiting, and the third day after the appearance of the eruption of scarlet fever. There was enlargement of the cervical glands and a profuse nasal discharge. Diphtheritic membrane was seen on each tonsil. The action of the heart was regular. A soft blowing systolic murmur was heard at the apex. There was a very brilliant eruption of scarlet fever over the entire body. The urine contained a slight trace of albumin. Five days after admission there was partial suppression of urine. Six days after admission the area of cardiac dulness was notably increased. The patient died on the ninth day after admission, and the thirteenth day from the commencement of the illness. At the autopsy acute endocarditis, acute pericarditis, acute splenitis, acute interstitial nephritis, parietal thrombi and fatty degeneration of the heart and kidneys were found.

Case 94. — A boy, three years of age, was admitted on the fifth day of his illness with a profuse nasal discharge, enlargement of the cervical glands, marked prostration, a diphtheritic membrane on the tonsils and uvula, and on the body a fading eruption of scarlet fever. The patient died on the fifteenth day after admission, and the twentieth day of his illness. Scarlet fever and diphtheria are equally responsible for this death.

Case 95. — A boy, two years of age, was admitted the fifth day of his illness. There was marked prostration, glandular enlargement and a profuse nasal discharge. A streptococcus membrane was found on the tonsils. There was an extensive broncho-pneumonia

of each lung. In this case there was a persistently high temperature. The patient died on the tenth day after admission, and the fifteenth day of the illness. At the autopsy fatty degeneration of the heart, liver and kidneys, acute broncho-pneumonia of each lung, and acute general lymphatic hyperplasia were found.

Case 96. — A boy, five years of age. He had been ill for five days. When admitted there was a profuse nasal discharge, marked prostration, enlargement of the cervical glands, a patch of diphtheritic membrane on each tonsil, a brilliant punctate eruption on the body and a temperature of 101°. The urine contained a slight trace of albumin. Cultures from the throat showed the presence of the bacilli of diphtheria. The patient did well for six days. The membrane disappeared from the throat, desquamation had commenced, the temperature was normal. The action of the heart, however, was rapid, and the sounds could not be distinctly made out. On the seventh day after entrance an examination of the heart revealed a *bruit de galop*. He died on the ninth day after admission, and the fourteenth day of his illness. Death in this case was probably due to the cardiac complication resulting from diphtheria.

Case 97. — A girl, seven months old, was admitted on the second day of her illness. There was a brilliant eruption of scarlet fever and a temperature of 103°. On the fifth day after entrance she developed a broncho-pneumonia, and died on the tenth day after admission, and the twelfth day of her illness. No autopsy. Broncho-pneumonia occurring as a complication in the course of scarlet fever was the cause of death in this case. This case is of interest, as it is a refutation of the statement frequently made that nursing infants are not susceptible to scarlet fever.

Case 98. — A boy, five years of age, was admitted on the second day of his illness. He had a high temperature and a very brilliant eruption. He died on the twenty-eighth day after admission, and the thirtieth day of his illness. Ten days before his death a broncho-pneumonia developed, but this was not extensive enough to have caused his death. From the clinical history of the case, from the manner of dying, it would seem that streptococcus infection was the most important factor in causing death. No autopsy.

A summary of these 98 fatal cases shows that scarlet fever was responsible for 56 deaths; that broncho-pneumonia caused 15; that diphtheria and scarlet fever caused 10; that diphtheria caused 9; that pneumonia was responsible for 4; that scarlet fever and erysipelas caused 1; that tubercular meningitis caused 1; and that two died from various complications.

In this study of 1,000 cases of scarlet fever it has been previously stated that the percentage of mortality, including moribund cases, was 9.8. If the 42 deaths, however, that were caused by complications occurring in the course of scarlet fever but not dependent upon it are eliminated from the 1,000 cases that have been observed, it will be seen that there were 958 cases of uncomplicated scarlet fever and 56 deaths, giving a percentage of mortality of 5.8. The average mortality from scarlet fever in the city at large, from 1892 to 1897, inclusive, was 8.52. Nephritis, pneumonia, bronchopneumonia, pericarditis, endocarditis, dilatation of the heart, otitis media and a streptococcus infection must be considered integral parts of the scarlatinal process. Diphtheria, on the other hand, although frequently occurring in the course of scarlet fever, is not essentially a part of the disease. There is no doubt that a scarlet-fever patient is particularly susceptible to diphtheria but the reverse of this is not true. Before bacteriological examinations were made of throats in scarlet fever, diphtheria and scarlet fever were considered to be more frequently associated than at the present time. In an analysis of these 1,000 cases, although a membrane was seen in a large proportion of them, yet cultures showed the presence of the bacilli of diphtheria in only a comparatively small number. The percentage of the cases that had a membrane diphtheritic in appearance, cultures from which contained the bacilli of diphtheria was 11.75. The percentage of those that had positive cultures without a definite membrane was 14.4. A very large proportion of the cases had a membrane in the throat of a white and glistening appearance, but repeated cultures failed to show the presence of the bacilli of diphtheria. A few cases were observed of laryngeal diphtheria associated with scarlet fever. Although laryngeal diphtheria and scarlet fever is one of the most serious combinations, yet about 50 per cent. of the patients recovered.

Albuminuria is generally considered to be a very constant symptom in scarlet fever, and uremia a very frequent cause of death. The urine of 790 patients was examined. It was impossible to obtain specimens in 210 instances, owing either

to the age of the patients or to their extreme illness. In 28.1 per cent. of the number examined no albumin was found. The slightest possible trace was found in 39.3 per cent. of the cases; a very slight trace in 4.5 per cent.; a slight trace in 9.3 per cent.; a trace in 6.8 per cent.; and a large trace in 2.7 per cent. If the amount of albumin was sufficiently large to be estimated by fractions of 1 per cent., it was observed that 2.4 per cent. had $\frac{1}{10}$ of 1 per cent., that 4 per cent. had $\frac{1}{8}$; that 1.9 per cent. had $\frac{1}{4}$. There were five instances in which the amount of albumin was $\frac{1}{2}$ of 1 per cent. Three of these patients died. In some of the fatal cases, if specimens of the urine could have been obtained, no doubt the amount of albumin found would have been quite large, as the patients when admitted were in a state of uremic coma. A small number of the patients who recovered had complete suppression of urine for a short time. There were three instances in which the acute renal trouble was followed by chronic disease of the kidneys.

The variation of the temperature in the different types of scarlet fever was very great. Five types of the disease have been observed. The first or malignant type causing the death of the patient in from twenty-four to forty-eight hours. It was noticed in this class that there were frequent hemorrhages from the mucous surfaces, and that the eruption was hemorrhagic in places. The temperature was usually very much elevated, but in some instances it was only 99°. The patient as a rule was unconscious. The second type was characterized by a moderately high temperature from 102° to 103°, marked throat symptoms, and a profuse nasal discharge. Streptococci were found in cultures from this discharge. Enlargement of the cervical glands was occasionally observed, but it was not a very frequent symptom. The temperature remained elevated for from ten to fourteen days, and came down by lysis. The patients were either mildly delirious or in a semi-conscious state. The eruption in most of these cases was very brilliant, but in a few instances extremely pale. In the third type there was a very high temperature and a brilliant rash. The throat symptoms although present were not specially prominent. No nasal discharge

was observed in this class. The temperature remained elevated for three or four days. In the fourth type the eruption although characteristic was not brilliant. It was most marked in the axillæ and in the inguinal regions. The subjective throat symptoms were not prominent, although an eruption could always be seen in the throat. The temperature was not specially elevated, being 99° to 100°. In the fifth type there was no eruption on the body. The hands were dry and hard. There was very little rise in the temperature. A faint eruption could be seen in the throat, which was always congested. There was slight dysphagia. The diagnosis in these cases was based on the enlargement of the papillæ at the tip and edges of the tongue. This enlargement of the papillæ is a constant symptom in scarlet fever, and has not been absent in any of the 1,000 cases observed. It has formed the basis of the diagnosis in many of the doubtful cases. A positive and correct diagnosis of scarlet fever *sine eruptione* can only be made from this symptom. There is no doubt that this form of scarlet fever is responsible for many of the unexplained outbreaks of the disease, and it is also a fact that this type is not fully recognized by the profession. That it is infectious must be conceded, and it may be assumed that, unless desquamation takes place the contagious stage lasts only about two weeks. In a given case it is impossible to say whether desquamation will take place or not. It has been said that there is no eruption, but this is not quite correct, for in some instances there is a slight erythema, but it is so evanescent in its nature that it very easily escapes notice except in hospital cases.

In the analysis of the 1,000 cases it was found that 37 had a temperature of 99°; that 134 had a temperature of 100°; 162 a temperature of 101°; in 191 instances the temperature reached 102°; it was 103° in 195 cases; that it was 104° in 158 cases; that in 113 cases it was 105°; and that in 10 instances the temperature was 106°. The temperature remained above 100° one day in 138 cases; two days in 186; three days in 166; four days in 105; five days in 68; six days in 51; seven days in 34; eight days in 38; nine days in 15; ten days in 28.

Enlargement of the cervical glands, followed by suppuration, is considered a frequent accompaniment of scarlet fever. In the 1,000 cases, enlargement of these glands was noticed 367 times. In 44 instances the glands suppurated, giving a percentage of 4.4. This is remarkably low.

The influence of the scarlatinal poison on the heart was observed in quite a large number of cases. A mitral systolic murmur was detected in 187 cases; *bruit de galop* in 5 cases; irregular action of the heart in 54 cases; endocarditis in 3; pericarditis in 5 cases. The area of cardiac dulness was increased to a greater or less extent in many of the cases. In a few instances dilatation of the heart took place very rapidly. Transitory murmurs of different kinds were quite frequently observed. In many cases, no doubt, these murmurs were hemic in their nature, but there were certain other cases in which they were evidently due to lack of tonicity of the heart. The heart muscle having lost its tonicity, is unable to contract sufficiently to close the valves tightly, hence the murmur. In some of the cases the murmur could not be detected when the patient was in bed, but after any exertion could be heard with distinctness. A similar condition has been observed in cases of diphtheria. It seems reasonable to conclude that these murmurs are due to the action of the scarlatinal poison on the muscular fibres of the heart, and not to the state of the blood. In some of these heart cases it was also noticed that the pupil of the eye was dilated to a considerable extent, and while it responded to light, it did not react as rapidly or as completely as in normal eyes. The dilatation in some instances was as marked as it is after the instillation of atropia.

Middle ear inflammation was found to be of quite frequent occurrence in this series of cases.

Acute rheumatism, so called, has been considered by some authorities a frequent complication in scarlatina. In this series of cases it was observed ten times. The attacks, however, were not very severe; in no instance was the effusion into the joints very great. The term scarlatinal rheumatism is a misnomer. The pain in the joints is not due to

rheumatism, but is the result of streptococcus infection, and should be treated as such, not as rheumatism.

Relapses in scarlet fever somewhat rarely occur, but second attacks of the disease are not so very uncommon. It is important to distinguish a true relapse from a pseudo-relapse. A re-infection must also be differentiated from a relapse. A true relapse occurs in from thirty-five to forty days after the disappearance of the exanthem, and would be ushered in with the usual symptoms. A pseudo-relapse or a *reversio eruptionis* takes place just after the disappearance of the eruption; sometimes, however, in ten days or as late as fifteen after the subsidence of all symptoms. A re-infection may take place about fifty days after the eruption has faded. The recurrence of the disease is as a rule not accompanied with very violent symptoms. Although death may occur, it is extremely rare. Thomas, in Ziemssen's Cyclopædia of the Practice of Medicine, Vol. 2, page 191, gives the following account of relapses among the crew of a British frigate. "The relapses among the crew of the frigate 'Agamemnon' occurred somewhat later than usual. According to Richardson, out of about seven hundred men, three hundred were affected the first time, so that the ship had to be cleared, thoroughly disinfected, and ventilated for more than one month. On April 4th it was again manned, and already, on April 9th, relapses occurred in eighteen of the one hundred and two convalescents who had returned to the ship; but the disease also recurred in many of those who had remained on land in the hospital, as also in one who had obtained furlough to return home. It is not reported how many days elapsed between the first and second attacks of the several cases; but as all the first attacks probably occurred in February, and the relapses in April, the interval evidently lasted much beyond one month in most cases. The second affection was either mild or as intense and characteristic as the first." Relapses were observed four times in this series of 1,000 cases. In one case there was a relapse, and shortly after a pseudo-relapse. The question of diagnosis has an important bearing on the subject of relapses, as in many cases reported it has been claimed that there was an

error in diagnosis, either in the first or second instance. A brief history of these cases may be of interest:

Case 1.— A boy, four years of age, was admitted on the day of the appearance of the eruption. There had been a rise of temperature on the previous day. The eruption was quite brilliant and perfectly characteristic; the tonsils were congested; the papillæ of the tongue were enlarged. On the fourth day after entrance the temperature was normal. Desquamation commenced at the usual time. The white line of commencing desquamation, at the junction of the pulp of the fingers with the nails was observed. The disease progressed favorably, and in thirty days the desquamative process was nearly completed. At this time there was a sudden rise in temperature, sore throat, enlarged papillæ of the tongue, and a brilliant characteristic rash of scarlet fever on the body. The patient was not seriously ill. Desquamation commenced in five days and pursued the usual course. There was no doubt of the correctness of the diagnosis in the initial attack; neither was there any question regarding the nature of the disease in the relapse. There was a slight amount of albumin in the urine in each instance. The patient made a good recovery.

Case 2.— A girl, three years of age. She was admitted on the second day of the disease. The symptoms, although mild, were typical. Desquamation commenced at the usual time, and went through the regular stages. On the thirty-first day after admission there was a repetition of the symptoms, rise in temperature, sore throat, enlarged papillæ of the tongue, and a typical rash. A slight trace of albumin was found in the urine each time. Desquamation was as profuse and as characteristic as in the previous attack.

Case 3.— A girl, three years of age, was admitted on the third day of her illness. The throat symptoms were prominent; a streptococcus membrane was found on the tonsils; the papillæ of the tongue were enlarged; the eruption was typical; more brilliant in the axillæ and in the groins. The temperature was slightly elevated. When she was nearly through desquamating she was suddenly taken ill with all the characteristic symptoms of scarlet fever of a mild type. The disease pursued the regular course. The patient made a good recovery.

Case 4.— A boy, four years of age, was admitted on the second day of his illness, with all the characteristic symptoms of scarlet fever. In this connection it is of interest to note that his brother was admitted at the same time ill with scarlet fever. When the patient was nearly through desquamation, he suddenly had a rise in temperature, sore throat, enlarged papillæ of the tongue and a brilliant rash over the entire body. He commenced to desquamate in a few days. Fifteen days after the relapse the

boy had a pseudo-relapse. In all of these attacks of scarlet fever the symptoms were pronounced and typical. In all there was a rise in temperature, a sore throat, an eruption in the mouth, enlargement of the papillæ of the tongue, and a brilliant punctate rash all over the body. There could have been no mistake in diagnosis in any one of the three attacks. The boy made a good recovery.

As a rule relapses are not attended with very grave symptoms. In these four cases the patients were not very seriously ill at any time. Recrudescence of the eruption is sometimes observed. This was noted only once in this series of 1,000 cases. In this case the eruption was quite brilliant at the time of entrance; it faded very considerably in three days; in five days after the patient was admitted to the hospital the eruption reappeared, and was fully as brilliant as on entrance. The temperature was not specially elevated, and did not rise at the time of the reappearance of the eruption.

The length of time that is required for desquamation has been stated by various authorities to be three or four weeks, but experience has taught me that a much longer time is required. The average period was, in these 1,000 cases, fifty days, but in some instances a much longer time was required. Clinical experience has demonstrated that just so long as there is any necrotic skin in the commissures of the fingers and of the toes just so long is the individual a source of danger to the community. The statement of certain recent observers that scarlet fever is contagious only during the period of the angina, and that it is not contagious during the period of desquamation, is not confirmed by clinical experience. In a comparatively small number of cases a secondary desquamation was observed. In a few cases a tertiary desquamation was noticed.

The researches in the bacteriology of scarlet fever at the hospital have been negative. It is true that in many of the cases streptococci have been found in cultures from the throat and from the nose. This has not been a constant symptom, and has only been observed in the very severe cases which renders plausible the theory that it is not the poison of

scarlet fever that causes the grave symptoms, but that they are due to streptococcus infection. Thus far no method of differentiation of the streptococcus found in scarlet fever from that of other streptococci has been discovered. From a study of these cases it is reasonable to suppose that the disease is not of bacterial origin, but that the cause is a protozoön. Limited investigations in this direction have been made, but without any result thus far.

A series of interesting and valuable investigations of the blood in scarlet fever, with special reference to leucocytosis, has been commenced by Dr. F. G. Burrows, Assistant Resident Physician at the hospital, but, unfortunately, owing to a sudden increase of work caused by illness of the house staff and an increase in the number of patients this paper cannot be prepared in time for issue in these reports. Thus far the results of this investigation by Dr. Burrows coincided in the main with those of R. Sevestre, M.D., published in Saint Bartholomew's Hospital Reports for 1896, Vol. 32, page 225 *et seq.* The conclusions of Dr. Sevestre are:

1. "There is a leucocytosis in scarlet fever which reaches its maximum in the first few days of the disease, but the return to normal is gradual.

2. "The actual time of onset of the leucocytosis is uncertain; it is found to be present on the first day of the disease, and it continues throughout the period of desquamation.

3. "No absolute relationship can be traced between the curve of the temperature and that of the leucocytes, but they tend to run a similar course.

4. "A closer relationship has been found to exist between the leucocytosis and the rash; the former varies with the severity of the latter, and with the fading of the same the leucocytes show a marked diminution in number.

5. "Complications such as otorrhea, rhinorrhea, adenitis, tend to increase the number of white cells.

6. "In nine cases the percentage of the various forms of white cells to the total number of white cells present was estimated. It was found that the percentage of the finely granular eosinophilous cells was greatly increased during the first few days of the disease; but within the next few days the percentage falls below the normal, and continues so for some considerable time. The large uninuclear cells and lymphocytes are diminished in number in the early part of

the disease; after a short time the percentages of both forms gradually increase, the large uninuclear cells remaining about normal, but the lymphocytes increase, and this increase exists for some time.

"In the majority of cases, the percentage of the coarsely granular eosinophilous cells was found to be diminished during the whole period of the disease. In no case were they found to be absent.

7. "A slight leucocytosis usually accompanied a mild infection.

"A high leucocytosis indicates a pronounced reaction against a severe infection, and is not a sign of an unfavorable prognosis.

"In severe cases it was found that the percentage of the finely granular eosinophilous was always high."

As only thirteen cases were examined by Dr. Sevestre, the conclusions that he draws might possibly be modified to a certain extent when a large number of cases has been examined.

The diagnosis of a characteristic attack of scarlet fever presents no difficulties, but the diagnosis of an atypical case of the disease is often extremely perplexing. One type of antitoxin rashes so closely simulates the eruption of scarlet fever that in some instances a positive and correct diagnosis at the outset is impossible. Initial vomiting occurs in about 80 per cent. of the cases, but this symptom may be due to many other causes and therefore no great amount of reliance should be placed on it as a means of diagnosis. The temperature is almost universally elevated, but there are cases of scarlet fever without any marked rise. Subjective throat symptoms, although occurring very frequently, are not sufficiently constant to be of any very great assistance in diagnosis. Objective throat symptoms, however, are always present in cases of scarlet fever, and therefore are of great aid in diagnosis. The appearance of a punctate eruption in the axillæ and in the groins together with the congestion of the tonsils and a punctate eruption in the roof of the mouth, no matter whether there is any eruption anywhere else or not, are positive proofs of scarlet fever. But the most important symptom and the most characteristic feature of the disease is the enlargement of the papillæ at the tip and edges of the tongue; this enlargement may be so slight as to be overlooked, but if a careful examination is made it will be found to be present in every case of scarlet fever. In not a single

instance in this series of 1,000 cases was this symptom wanting, and in many instances it was the basis of the diagnosis. There are two varieties of this enlargement: in one the papillæ look very much like small grains of cayenne pepper sprinkled on the tongue; in the other the papillæ have a button-like appearance, and are very considerably elevated, but not specially reddened. The strawberry tongue of scarlet fever, on which considerable stress is laid, is simply an exaggerated form of this condition. This enlargement of the papillæ of the tongue is often of more assistance in arriving at a correct diagnosis than the appearance of the eruption itself, but it must be seen to be appreciated; it cannot be described. This symptom appears very early in the disease — sometimes before the eruption is seen on the skin — and may continue for some twenty to thirty days. In the paper of Dr. R. M. Pearce, page 39, of these reports will be found a full description of the histological appearances of these enlarged papillæ occurring in fatal cases. It is perfectly true that sometimes enlarged papillæ of the tongue are seen in measles, but this appearance is entirely different from that seen in scarlet fever; as different as is the eruption of measles from that of scarlet fever. In scarlet fever it is often important to make a diagnosis after the disappearance of the eruption, and the existence of a white line at the junction of the pulp of the finger with the nail, showing commencing desquamation, is often of very great assistance. This white line can almost invariably be seen before the commencement of desquamation in other parts of the body, particularly in mild attacks of the disease. There is no doubt that many unexplained outbreaks of scarlet fever could have been traced to their source by a careful examination of the papillæ of the tongue and the tips of the fingers.

In the treatment of scarlet fever rest in bed for the first two or three weeks, even though the patient may have a normal temperature is all important. The rest in bed diminishes the probability of renal complications and lessons the chance of heart trouble. The diet should be non-irritating and preferably of milk. Irritant diuretics should not be used. Tincture of chloride of iron is of doubtful advantage.

Alcoholic stimulation is required in the graver cases. Cervical adenitis before suppuration takes place should be treated by the ice-collar. If the temperature is above 103° it should be reduced by cold bathing. The sponge bath, the cold pack, the milk pack or the fan bath may be given. The effect of the cold bath in calming the delirium and in reducing the temperature is very gratifying. Many cases have been observed in this series where the temperature was 105°, and the patient was wildly delirious, but after a bath was given the delirium was quieted, the temperature was reduced from two to three degrees, and the patient would have a few hours of refreshing sleep. In many instances it was necessary to repeat the baths quite a number of times, but in no instance was there any injurious effect, either direct or remote, from the bathing. It may be said that the effect of the bath is only temporary, and this is quite true, but the temporary relief that the patient experiences is sufficient frequently to turn the scale in the right direction. Tub baths have not been used because equally good results can be obtained from the sponge baths. Occasionally the milk pack has been given, which is simply substituting milk for water. It seemed as if the effect was more permanent than that of the sponge bath. When the temperature is exceedingly high, the patient extremely delirious, and the pulse of good strength and volume, the fan bath has been used with satisfactory results. In giving the fan bath the patient is wrapped in gauze, which is sprinkled with water and then an attendant stands on each side of the patient and fans him for ten or fifteen minutes. A brief allusion may be made to one case in which the result was eminently satisfactory. The patient in this instance was a young man with a temperature of 105°, a very brilliant eruption, violent delirium and a full and bounding pulse. He had not slept for forty-eight hours. The fan bath was given; the temperature dropped to 102°; the delirium was quieted; the pulse became less full and bounding, and the patient went to sleep. The temperature did not rise again, neither did the patient become delirious. He made a good recovery without complications. If the pulse is weak and extremely rapid, alcoholic

stimulation should be administered before giving the bath. Coal-tar products should not be used in scarlet fever for the purpose of reducing the temperature. When we consider the possibility of a lack of tonicity of the heart muscle occurring in scarlet fever, it is evident that the use of the coal-tar products is not justifiable. It is true that in a comparatively mild case of scarlet fever with a temperature of 103°, one or two doses of phenacetin or some of the similar compounds might do no harm, but the routine use of these agents in severe attacks of scarlet fever cannot be too strongly deprecated. Digitalis is of great use in the treatment of certain of the heart complications occurring in scarlet fever, and it would seem as if more satisfactory results had been obtained from its use than from strophanthus. In the renal complications flushing out the kidneys with liberal draughts of water has seemed the most satisfactory method of treatment. Many cases might be cited in which the administration of water in large quantities was followed by most gratifying results. When there was suppression of urine, hot packs have been used, and in certain instances pilocarpin has been administered subcutaneously. It is doubtful if the use of pilocarpin was beneficial; it is certain that many patients were greatly benefited by the hot packs. Inunctions of vaseline have not been used to any very great extent, because they did not seem to have any marked effect in reducing the temperature or in adding to the comfort of the patient. The importance of paracentesis of the membrana tympani where there is any bulging cannot be too strongly emphasized.

From the examination of the health reports both in this country and in Europe and from the study of these 1,000 cases the following conclusions may be drawn:

1. That scarlatina is more prevalent in Boston than in some of the larger foreign and American cities.

2. That scarlatina has diminished in frequency in Boston during the past three years, owing to the establishment of an isolation hospital sufficiently large to accommodate all applicants.

3. That the death-rate of scarlatina in the hospital, considering the class of cases that are treated, is remarkably low.

4. That the period of isolation in scarlatina, in order to be effectual should be continued for a long time, at least fifty days.

5. That rest in bed and a non-irritating diet during the first few weeks of the illness are very important factors in reducing the frequency of renal complications in scarlatina.

II.

SCARLET FEVER, ITS BACTERIOLOGY, AND GROSS AND MINUTE ANATOMY. (Plates I. and II.)

By Richard Mills Pearce, M.D.

In this report are recorded the results of the examinations of twenty-three cases of scarlet fever. Attention has been given, chiefly, to the histology of these cases; but in order to make the report more complete a brief consideration of the gross lesions and of the bacteriological examinations has been incorporated.

The cases are all from the service of Dr. J. H. McCollom of the South Department (Contagious Service) of The Boston City Hospital.

In selecting the cases, only those have been chosen in which the clinical diagnosis was perfectly clear. All cases which bacteriologically showed the presence of the bacillus of diphtheria have been disregarded. All cases complicated by other infectious diseases of childhood, or by tuberculosis, have been ruled out.

The clinical histories of these cases are so similar that they have not been given in detail, but in the appendix may be found a few facts in regard to the length of the disease, the height of the temperature, and the nature of the complications. Cases which presented unusual features have been given a more complete history. In the appendix, also, may be found the anatomical diagnosis and the result of the bacteriological examination in each case.

The work has been done in the Pathological Laboratory of The Boston City Hospital at the suggestion, and under the direction, of Dr. W. T. Councilman, from whom, as well as

from Dr. F. B. Mallory, I have received much valuable assistance. For the photomicrographs I am indebted to Dr. Councilman.

The subject will be considered in the following order:

1. *Gross lesions.*
   (a) Review of previous investigations.
   (b) The appearances in the present series of cases.
2. *Secondary infections with resulting lesions.*
   (a) Review of the literature.
   (b) The secondary infections in this series of cases.
3. *Histology.*
   The histological examination of each organ or tissue is described separately, and is preceded by a review of the literature.
4. *Kidney.*
   (a) Literature.
   (b) Gross pathology.
   (c) Histology.
5. *Summary.*
6. *Appendix of cases.*

1. GROSS LESIONS.

The gross lesions of scarlet fever are slight. The text-books describe changes in the skin, tongue and throat, and hyperplasia of the lymphatic apparatus, which includes not only hyperplasia of the large lymph nodes found in the subcutaneous tissues, but also the lymph nodules of the alimentary canal and respiratory passages. Cloudy swelling or fatty degeneration of the liver and kidney has been noted in some cases. Occasionally the spleen is described as being enlarged. The above changes may be considered as characteristic of uncomplicated scarlet fever. All other gross lesions are to be considered as sequelæ or as the result of local or general infection.

Harley (1872), after studying twenty-eight cases with post-mortem examinations, concluded that scarlet fever was a disease of the lymphatic system, characterized by hyperplasia, most marked in the lymph nodes, spleen, tonsils and intestines. The lymph nodes of

head and neck showed the greatest enlargement. The tonsils were generally enlarged. In twenty-three cases the spleen was enlarged; in children it was firm, in adults, normal or soft. In one case there was ulceration, with hemorrhage, of the solitary lymph nodules of the intestine; in another purulent arthritis; and in two, abscesses of cervical lymph nodes. Nephritis was observed in one case.

The hyperplasia of the lymph nodules of the intestine frequently has been observed. It is the "psorenterie" of French writers, the "non-typhous intumescence of the follicles" of Rokitansky, and the "granulation of the intestinal mucous membrane" of others. Litten divided the intestinal changes into three classes; first, catarrhal colitis; second, diphtheritic colitis involving colon and rectum; third, a typhoid form with hemorrhage, swelling of Peyer's patches, solitary lymph nodules, spleen and mesenteric lymph nodes. He also described diphtheritic ulcers of the gums, œsophagus and stomach.

Tüngel reported a diphtheritic exudate on the mucous membrane of the ileum. Ulcerative changes in the œsophagus, stomach and intestine have also been noted by Henoch, Deiters, Crooke and Foote.

Wagner, Huguenin and Biermer reported cases in which the liver both on the surface and on section showed numerous very minute whitish points, which in two cases were composed of lymphoid cells and in the other of connective tissue. In Beimer's case there was also an enormous enlargement of the Malpighian bodies of the spleen, while in Huguenin's case there was a diphtheritic pyelitis.

Gross appearances in this series of cases.

Skin. — In six cases, all before the fifth day, there was a fine, diffuse, dusky redness over all parts of the body. This was not limited to dependent portions of the body, but was well marked over chest and limbs. It was evidently the remains of the scarlet fever eruption present during life.

Two cases, fatal on the twelfth and fourteenth days respectively after the beginning of the eruption,[1] showed fine, subcutaneous hemorrhages.

Three cases showed a fine desquamation. In the other cases the skin was negative. In some cases a peculiar edema of the subcutaneous tissue of chest and neck was observed.

[1] As in most cases the date of the beginning of the eruption can be determined more definitely than that of the earlier symptoms, all changes have been reckoned from that time.

Tongue. — In most cases the gross appearance of this organ was negative. In a few of the very early cases the papillæ, particularly those at and near the tip, were more prominent than normal.

The mucous membranes of *mouth* and *respiratory passages*, in most cases, were congested; and the latter showed a more or less marked catarrhal condition. The *tonsils*, generally, were much increased in size, the crypts were often distended, and in some cases contained small masses of compressed desquamated epithelium. In one case there was extensive necrosis of one tonsil, and in three cases a slight superficial necrosis of one or both tonsils. Marked edema of the larynx was noted in one case, and a superficial necrosis of the epiglottis in another.

Alimentary Canal. — In one case (97–144)[1] the œsophagus in its upper posterior portion showed an irregular loss of substance 3.5 by 2 cm., with irregular indurated edges, and an uneven base covered with a soft, grayish slough. In another case (97–241)[1] there were in the mucous membrane eight small abscesses, varying from 2 to 3 mm. in diameter.

The condition of the œsophagus in these two cases is of interest in view of the case recently reported by Ehrlich (1898). In this case a boy, five years old, who two years before had had scarlet fever with severe ulceration of the throat, showed a cicatricial stricture of the œsophagus, demanding operation. Ehrlich states that the only case of stricture of the œsophagus with similar etiology is reported by Eiselberg.

In several cases there were small hemorrhages beneath the mucous membrane of stomach and intestine. In all cases there was more or less hyperplasia of the lymph nodules of the intestine. In the early cases the Peyer's patches were exceedingly prominent; the swelling being almost as marked as that of typhoid fever. The solitary lymph nodules of the large intestine were equally prominent.

Liver. — In all but one case the gross examination of the liver was uninteresting. In this one case (97–144) there were

[1] These numbers refer to the numbers in the autopsy records of The Boston City Hospital, where the autopsies are numbered consecutively for each year.

present everywhere on the surface of the liver and throughout its substance small yellowish, opaque, non-purulent, non-elevated areas, each about 1 mm. or less, in diameter. Upon histological examination these proved to be areas of necrosis. (See page 62.) This is the case which is described above as having an ulceration of the œsophagus and in which there was also an acute interstitial nephritis and a general streptococcus infection. In the other cases, the liver occasionally showed cloudy swellings, and in three cases it appeared extremely fatty.

Spleen. — According to gross appearance the spleens of this series of cases may be divided into two classes; first, and more commonly, those in which there was no increase in pulp, but a marked enlargement of the Malpighian bodies. In such cases the spleen was firm, capsule smooth but not tense; on section it presented a dark-reddish background, dotted everywhere with regularly or irregularly enlarged Malpighian bodies. The trabeculæ were faintly visible. This condition of the spleen was noted in thirteen cases.

The other class includes those cases in which the splenic pulp was greatly increased and the Malpighian bodies indistinct. The spleen was large and soft, and its general appearance corresponded closely to the spleen of typhoid fever. This condition was found in seven cases, in two of which, however, there was enlargement of the Malpighian bodies.

In the remaining three cases absolutely no change in the gross appearance of the spleen could be made out.

Why this difference should exist is not apparent. A study of the cases shows that it cannot depend on the age of the patient, the stage of the disease, the presence of complications, the presence or absence of general infection, or on the character of a general infection. It is true that six of the seven cases with soft spleen died on the third to fifth day of the disease. But four of those with the firm spleen also died during the same period. So that the stage of the disease cannot have a very important bearing on the condition of the spleen.

Lymph nodes. — The mesenteric, retroperitoneal, bronchial, tracheal and cervical nodes were examined in all cases; the

inguinal and axillary in many. They were all found enlarged, quite firm, and on section pale and watery. They were never soft and pulpy as sometimes seen in typhoid fever. The cervical lymph nodes showed the greatest enlargement, and the axillary and inguinal the least.

Bone marrow (of femur). — In children this tissue was of a uniform dark red color, and soft in consistency. In two cases, aged seventeen and eighteen years respectively, it was of a grayish red color. In one case, twenty-seven years of age, it was grayish red near the epiphyses, and yellow with reddish streaks near the middle of the bone.

2. SECONDARY INFECTIONS WITH RESULTING LESIONS.

While the bacteriology of the complications of scarlet fever has been satisfactorily worked out, the cause of the disease itself still remains unknown. All bacteriological methods employed to demonstrate the infecting agent have proved futile. Examination of the blood during life in the few instances in which it has been attempted has failed to demonstrate the presence of protozoa.

A host of investigators testify to the presence of cocci in the desquamating skin, on the respiratory mucous membranes, and in the various secondary inflammatory complications. A streptococcus which cannot be differentiated from the streptococcus pyogenes is the organism most commonly found.

Klaman (1883) described the presence of cocci in the desquamating skin, and mentioned over 50 investigators who had also found cocci on the skin and mucous membranes. Cocci in the organs of the throat and in the internal organs have been observed by Crooke (1885) in 30 cases. Fränkel and Frendenberg found streptococci in various organs. Raskin found them in the heart's blood and in suppurating lymph nodes and joints. Heubner, Bahrdt, Leubartz, Loeffler, Kurth, Crookskank, Wright, and Babes have made similar observations ; the latter found streptococci constantly in the kidney. Bourges found the streptococcus in the throat in 26 out of 30 cases examined. Lemoine in a study of 117 cases of scarlet fever angina found the streptococcus alone in 93 cases, and associated with other organisms in 14 cases. The streptococcus has been found in the throat by Baumgarten, Raskin, Prudden and many others. That it

may cause the false membrane often seen in the throat of scarlet fever not complicated with diphtheria is quite generally conceded. There is, however, no reason for believing that it may be the cause of the disease. Seitz (1898), after a study of 800 cases, decided that neither bacteria nor protozoa can be considered as the cause of the disease. He considered the streptococcus the most common secondary invader.

Secondary inflammatory processes are those involving the lymph nodes, subcutaneous tissues, lungs, pleura, joints and middle ears. Gluck, in summing up the surgical complications of scarlet fever, considered the following as the order of frequency; first, inflammation of the lymph nodes, generally sub-maxillary; second, abscesses of the subcutaneous tissue; third, suppuration of the joints; fourth, empyema; fifth, inflammation of the middle ear. These complications are common to all the acute infectious diseases of childhood, but they occur more commonly in scarlet fever. This is particularly true of diseases of the middle ear. Burckhardt-Merian in 85 cases found both ears affected in 84.7 per cent. Of 4,309 cases of acquired deafness he considered 10.3 per cent. to be the result of scarlet fever.

Broncho-pneumonia, according to all investigators, is one of the most frequent and fatal complications of scarlet fever. Among the unusual complications are, a case of suppurative myocarditis reported by Goodhardt, and one of cardiac parietal puriform thrombi reported by Foot. Hypertrophy of the left ventricle of the heart in cases of glomerulo-nephritis has been reported by Wagner and Klebs.

In the secondary inflammatory processes the streptococcus is the organism most often found. Next in frequency is the staphylococcus pyogenes aureus. Wright, in cases of broncho-pneumonia, found the streptococcus commonly, the pneumococcus occasionally. Netter and Queissner found the streptococcus and the pneumococcus separately, combined, or associated with staphylococci. Netter also reported the streptococcus in cases of pleuritis, acute inflammation of the middle ear and in acute abscesses.

The middle ears. — In eight cases an acute inflammatory condition was found. In all but one case both ears were involved. In one case the mastoid cells were also infected. In five cases dying on the eighth, ninth, tenth, twelfth and fourteenth days respectively, the exudate in the middle ears was distinctly purulent. In the other three cases, two dying on the third day and one on the eighteenth day after the appearance of the eruption, the exudate was mucoid in its gross appearance, but microscopically showed numerous pus cells. This mucoid exudate appears to be characteristic of the

early stage of acute middle ear disease. It has been noticed in several cases of diphtheria, scarlet fever and measles dying early in the course of the disease.

The fact that an infection of the middle ear was found in two cases dying on the third day would indicate that an involvement of this organ may occur much earlier than is generally supposed.

Of the purulent cases, in two the streptococcus was found in both ears. In one case the streptococcus occurred in one ear, and the pneumococcus in the other. In a fourth the only organism present was the staphylococcus albus.

Of the cases with mucoid accumulation, in one (unilateral) the streptococcus was found. In another (bilateral) the cultures were sterile. In the third case no cultures were taken.

Antra of Highmore. — In three cases an inflammatory condition of these cavities was found. In two cases both cavities were filled with abundant purulent fluid, and the process was a true empyema. In both of these cases both middle ears were infected, and in one of them the sphenoidal sinus was filled with greenish yellow pus. In this last case cultures showed, in all three cavities, a variety of organisms from which were isolated the staphylococcus pyogenes aureus and albus, and the bacillus pyocyaneus. In the first case the streptococcus and the staphylococcus pyogenes aureus and albus were found. In the third case only the right antrum was involved, and the material was mucoid in character. Smears of this material showed pus cells, numerous streptococci and a few diplo-bacilli.

Pulmonary complications. — In eight cases broncho-pneumonia was present occurring, usually, as small discrete nodules scattered along the back or base of the lung. In two cases the process was confluent, involving the greater portion of one or more lobes.

In five of these cases both the streptococcus and the staphylococcus pyogenes aureus were found. In one case the latter was found associated with the pneumococcus. In one case the streptococcus was found alone.

In one case there was a sero-fibrinous pleurisy due to the streptococcus and in another an empyema with atelectasis of the lung. In the latter a small abscess cavity was found

on the surface of the lung. Cultures in this case showed the streptococcus and the pneumococcus.

In several cases small areas of atelectasis were found associated with bronchitis or broncho-pneumonia.

In two cases small foci of hemorrhage .5 to 2 cm. in diameter were found scattered through the lung substance. In one of these cases there were also small, sub-pleural and sub-pericardial ecchymoses.

An embolic pneumonia was found in one case. In the other thirteen cases the lung showed nothing of interest.

Acute mitral endocarditis was found in a case with general streptococcus infection.

Abscess of cervical lymph nodes was found in four cases. In one of these cases the cultures showed the streptococcus, and in another the staphylococcus pyogenes aureus. As the other two cases had been operated on and treated antiseptically, cultures were not taken.

Embolic abscesses. — Case 98–34 [1] developed an erysipelas of the scalp on the fourth day after the appearance of the eruption. Cultures from this showed the staphylococcus pyogenes aureus and the streptococcus. At the autopsy were found embolic abscesses of the lung and kidney, an acute fibrinous pleuritis and an acute pericarditis. Cultures demonstrated the presence of the streptococcus and staphylococcus pyogenes aureus in the heart's blood, liver, spleen and kidney, in the secondary abscesses and in the pleuritis, while in the pericarditis the staphylococcus pyogenes aureus only was found.

Case 97–385 [1] had an acute diphtheritic endometritis; cultures from the uterus showed the streptococcus and the colon bacillius; there was no general infection.

Case 97–158 [1] had an acute peritonitis following an inflammation and perforation of a Meckel's diverticulum. Cultures

[1] By some the rash in these last three cases may be considered that of a surgical septicemia and not that of scarlet fever. That this is not the case is shown by the fact that in case 98–34 a typical scarlet fever rash was fading when the erysipelas developed. In the second and third cases there was no general infection and the appearance of the tongue and throat was characteristic of scarlet fever. In regard to the latter Osler says that "while scarlet fever may attack a person after operation or a woman in child-bed, the majority of cases described as such, belong, I believe, to those of septicemia. In the cases which I have seen the rash was rarely so widespread as in scarlet fever; the tongue had not the special features, nor was the throat affected"

showed a variety of organisms; colon bacillus most prominent, no general infection.

General infection. — Of the eleven cases in which there was a general infection, the streptococcus was found in nine. In six of these cases it occurred alone, and in three was associated with the staphylococcus pyogenes aureus. Infection with the staphylococcus pyogenes aureus alone occurred in one case, and with the pneumococcus alone, in one case.

In all but two of these cases there was some local inflammatory condition, such as broncho-pneumonia, cervical abscess or middle-ear disease, which probably served as an infection-atrium.

Nothing has been observed in the study of these cases that throws light on the etiology of scarlet fever. In the routine bacteriological examination of the throat and nasal passages the streptococcus has generally been found, usually in large numbers. It has also been found to be the most frequent organism causing a general infection, and also as the organism most often found in the complications. It is, therefore, the most important factor in the secondary inflammatory complications, but the evidence is not sufficiently strong to indicate that it has an etiological importance.

3. HISTOLOGY.

Methods. — In all cases tissues have been hardened in Zenker's fluid, imbedded in parafin, and stained with Unna's alkaline methylene blue, preceded by aqueous eosin. A few cases have also been stained with safranin, or with eosin and hematoxylin. Gram-Weigert's and other differential methods have been used when necessary.

Skin. — No extensive histological study of the skin of scarlet fever has been made. With the exception of the work of Klein and Unna the literature shows no investigator who has studied more than two or three cases.

According to Simon the exudative process which causes the swelling of the cutis in measles does not occur in scarlet fever.

Löschner found in cadavers, a few days old, a chemically peculiar exudation in the rete Malpighii, the nature of which he could not determine, and in which were exudative cells of variable number, form and size.

Thomas considered that the cutaneous affection of scarlet fever was not merely a hyperemia but was also characterized by an exudation into the rete Malpighii.

Fenwick, in the study of three cases, found the rete thickened and containing numerous cells with large nuclei. The epithelium and sweat glands were thickened and became detached, leaving a thickened membrana propria. Some of the sweat glands contained coagulated blood. In some places the sweat canals and the upper layers of the epidermis had a reddish discoloration, evidently due to blood staining. The deeper layers of the skin were normal.

Kaposi described a hyperemia with moderate exudation and with cell proliferation in the papillæ and rete, and blood extravasation in the papillæ and cutis.

Klein (1876), in a study of twenty cases, described the following changes: The epidermis is slightly thickened. Many cells of the superficial and deep layers of the rete contain double or dividing nuclei. In the epidermis at the boundary between the rete and the stratum corneum are small spaces containing granules which look like micrococci. In the rete Malpighii are lymph corpuscles with one or two deeply staining nuclei. The rete is thickened. There is an increase of the nuclei of the epithelial cells of the hair follicles and sweat glands in the papillary layer of the corium. The lymph channels are distended and contain an occasional wandering cell. The blood vessels are distended by corpuscles and sometimes fibrin. The nuclei of the lymphatics and of the endothelial and muscular coats of the arteries are increased. In one case the blood was found in the sweat glands.

Bohn believed that the process began in the deeper layers of the epidermis, and was essentially a serous infiltration.

Remy studied one case during the eruption. He found the changes most marked in the dermis, particularly the papillæ. The capillaries were dilated, and contained clotted blood, fibrin and an increased number of white cells. The lymphatics also contained many leucocytes. No nuclear changes or infiltration with leucocytes was observed in the epithelium. There were no changes in the glands.

Neumann found the rete cells swollen, the prickly cells long drawn out, and between them spaces, in which were exudate cells. In places the epithelial cells were separated by circumscribed extravasations of blood. Exudate cells were seen in the horny layer. The blood vessels and lymphatics were dilated. Slight proliferation around the sweat glands, hair follicles and blood vessels was noticed.

Delafield and Prudden describe the process as a simple dermatitis. The papillæ and subpapillary tissues are infiltrated with leucocytes. Later, an increase of epithelium takes place.

Unna (1894), after studying seven cases, summed up the results as follows: At the height of the eruption the epidermis is shrunken. There is no edema of the cutis; no mitosis except in the transitional and horny layers. The vessels of the cutis and papillæ are dilated. Toward the end of the eruptive period and at the beginning of desquamation there is an emigration of white blood corpuscles, a few of which may be seen in the epithelium. Around the vessels of the papillæ are small collections of connective tissue cells. There is no formation of plasma cells. Mast cells, except in the desquamative stage, are not numerous. At the height of the desquamation, mitosis is marked. There is an increase of cells in the upper layers of the epithelium and around the blood vessels. He considers the process to be a vaso-motor disturbance caused by the scarlet fever poison, and not a true inflammation.

Skin. — Nine cases were examined, all between the second and sixteenth days, except one on the thirty-second day.

On the second day, beyond a congestion of the blood-vessels and slight dilatation of the lymphatics, no changes were observed. On the third day (three cases), in addition to the above, a few leucocytes and lymphoid cells were seen in and grouped around smaller lymphatics beneath the rete Malpighii. From the fifth day to the tenth day, the most marked condition was an infiltration of the epithelium with polymorphonuclear leucocytes. The nuclei of these cells could be seen elongated and distorted, forcing their way between the cells of the rete. In the superficial portions, where the epithelium was beginning to desquamate, the leucocytes were collected in large numbers between its layers. This was seen more particularly in the hollows between the papillæ. The cells, apparently, leave the blood-vessels beneath the rete, pass up between the epithelial cells and collect in the superficial layers of dead cells, with which they are thrown off. In many cases leucocytes and red blood corpuscles could be found mixed with the desquamated epithelial cells. In the connective tissue beneath the epithelium were numerous polynuclear leucocytes and a few plasma cells. The lymphatics were widely dilated, and contained many leucocytes.

The epithelial cells did not stain well, and many were vacuolated. The deeper cells showed an occasional mitotic figure.

By the twelfth and sixteenth days the leucocytic infiltration had nearly disappeared. An occasional distorted or fragmented nucleus was seen between normal looking epithelial cells. In the desquamating cells the leucocytes were seen occasionally in small numbers. Around the blood-vessels and lymphatics of the subcutaneous tissue were small collections of round cells.

No cases were obtained between the sixteenth and the thirty-second days. A case on the thirty-second day showed slight superficial desquamation. The rete Malpighii contained numerous mitotic figures. Around the blood-vessels and lymphatics of the subcutaneous tissues was a slight increase of round cells.

Tongue. — The histology of the tongue of scarlet fever appears to have been neglected. I have been able to find but one description, that of Klein, who studied the tongue in eight cases. He found evidences of an acute inflammation, as shown by distended blood vessels containing fibrin and many leucocytes, leucocytic infiltration of the mucosa near veins and capillaries, and of the superficial epithelial cells. He observes that the more distinct the leucocytic infiltration of the epidermis the more marked is the desquamation. The migratory cells reach the superficial epithelium through enlarged intercellular spaces. The accumulation of leucocytes is most marked in the fungiform papillæ. There is a proliferation of the nuclei of the nerve sheaths, striped muscle fibres, and the endothelial and muscular coats of arteries.

Tongue. — Eight cases were examined, all between the second and ninth days, except one on the thirty-second day. The process in the tongue is similar to that in the skin, but is much more marked and begins earlier.

In all cases on the surface of the tongue there was considerable dead epithelium containing numerous bacteria, chiefly cocci. The superficial cells were granular and did not stain well, and there was often a perinuclear space. Mitosis in the deeper layers was frequent.

In addition to the above, in two cases dying on the second day, there was considerable infiltration of the epithelium with polymorphonuclear leucocytes. The infiltration was more marked in the epithelium over the papillæ, and in the

papillæ at the tip more than at the base of the tongue. In the tissues beneath the epithelium the blood vessels and lymphatics were dilated, and the former contained numerous leucocytes. There were also numerous leucocytes and a few plasma cells outside the vessels. The mast-cells appeared to be increased in number.

On the third day the infiltration had rapidly increased, the leucocytes were collected in the superficial layers of the epithelium, and a few were found, with red-blood corpuscles, in the desquamated epithelium.

The most extreme infiltration was seen about the fourth to ninth days. In a case dying on the fifth day (97–385) the leucocytic infiltration was most intense. Everywhere large numbers of distorted nuclei could be seen forcing their way between the epithelial cells. In the superficial layer, where the cells were dead and did not stain well, several leucocytes could be seen replacing a single epithelial cell. On the surface, where the epithelium was beginning to separate, the leucocytes were collected in large numbers in the spaces thus formed. The infiltration of the lower layers of epithelium was extensive, but not so marked as near the surface.

About the eighth and ninth days the infiltration with leucocytes lessens. They were still abundant in the desquamating layers, but in the deeper layers only a few were seen. In the connective tissue of the papillæ were small collections of lymphoid and plasma cells and a few leucocytes.

The tongue was not studied in any case between the ninth and thirty-second days. In a case of the latter date the epithelium showed no diffuse acute process. At one point there was a very slight loss of epithelium over one papilla with a slight collection of fibrin and leucocytes. In the connective tissue of the papillæ was a slight increase of cells consisting principally of lymphoid cells with a few plasma cells. The mast-cells were increased in number. Mitotic figures in the epithelium were numerous.

In two cases slight ulceration of the tongue was noted macroscopically. In one, a case in which death occurred, on the third day, in addition to slight infiltration of the

epithelium with leucocytes, there was a small area over which the epithelium was lost, and its place occupied by dead cells, cocci, fibrin and leucocytes. Between the slough and the tissue beneath was a zone of distinct chains of streptococci. The muscular tissue beneath was slightly infiltrated with leucocytes.

In another case, in which death occurred, on the ninth day, in addition to a marked general infiltration of the epithelium, there was at one point a complete necrosis of the epithelium with ulceration. The surface of the ulcer was covered with fibrin, leucocytes and masses of cocci, which extended quite deeply into the underlying tissues. In the muscular tissue, and distinctly separated from the ulcer, were two cellular foci, composed mainly of leucocytes with a few lymphoid and plasma cells. In these foci were several chains of streptococci. A small blood vessel also contained streptococci. Large mast cells were numerous in the immediately surrounding tissue.

These were the only two cases in which, in the acute stage, there was a loss or change of epithelium which might be considered an infection-atrium.

From the study of the skin and tongue of these cases it would appear that the changes in these tissues are not merely vaso-motor, but also inflammatory. That the changes in the tongue are more marked is probably due to the character of its tissues. They are more moist and more vascular.

The marked involvement of the papillæ explains their enlargement during life. That the tongue lesions appear earlier, and are more marked than those of the skin, agrees with clinical observation.

The exciting cause of the leucocytic infiltration may be a positive chemotaxis exerted by the presence in the tissues of the scarlet fever toxin; or by substances formed by its action on the superficial epithelial cells.

Organs of the neck. — Klein described the same inflammatory changes in the palate, tonsils, pharynx and œsophagus as were found in the tongue. He also described superficial ulcerations which might occur in the soft palate, pharynx or larynx. In the larynx and

trachea the epithelium was increased and flattened. The mucous glands were partially or completely destroyed and infiltrated by lymphoid cells. The lymph nodules of these structures showed large transparent cells with ovoid nuclei. Some of these large cells contained many nuclei. The small lymphoid cells had disappeared.

Mucous Membranes of the Throat and Nose.

Pharynx. — Examined in six cases. The changes were similar to those in the tongue; the vessels and lymphatics dilated; diffuse increase of plasma and lymphoid cells; some edema. In cases earlier than the third day there was little change in the epithelium. In cases later than this a leucocytic infiltration was seen. This was most marked in a case dying on the twelfth day.

In a case of the fourteenth day there was a diphtheritic membrane in which were many streptococci. The process extended down into the muscular tissue which was infiltrated with leucocytes, lymphoid and plasma cells.

In a case on the third day a small abscess containing many streptococci was found in the lymphoid tissue.

Œsophagus. — Examined in three cases. In two which died on the third and eighth days, respectively, nothing of interest was observed except, in the latter case, a great increase of nuclear figures in the epithelium.

In case 97–144 (fourteenth day) there was a loss of substance extending down to the muscular tissue, which was infiltrated with large numbers of lymphoid and plasma cells. There were a few polymorphonuclear leucocytes. On the surface were numerous cocci.

Soft palate. — Examined in six cases. The changes were similar to those in pharynx, but the edema was more marked, as was also the infiltration of the sub-epithelial tissues by leucocytes and plasma cells. In a case on the third day there was a slight loss of epithelium with invasion by streptococci.

The tonsil. — Examined in six cases. The changes were similar to the above. The leucocytic infiltration was, however, more extensive. The crypts were filled with desquamated epithelial cells, leucocytes and bacteria.

The latter were chiefly cocci. The blood vessels were congested. Numerous plasma cells, some of which were in mitosis, were scattered throughout the tonsillar tissue. Mast-cells were numerous. Many of the leucocytes were eosinophilic. In three cases (second and third day) small abscesses containing streptococci were found.

Larynx and epiglottis. — Examined in four cases. Showed nothing of interest except in a case dying on the thirty-second day. In this case there was considerable edema of subepithelial tissue with a slight accumulation of lymphoid and plasma cells.

The mucous membrane of the mouth, examined in one case only, was negative.

The lining membrane of the antrum of Highmore examined in one case only, showed a normal epithelium, congestion of the blood vessels, edema of the connective tissue and considerable numbers of plasma cells and eosinophilic leucocytes. (From the case, with mucoid accumulation, described above.)

The mucous membrane of the turbinate bone examined in one case showed nothing of interest.

Stomach and intestines. — Fenwick found the blood vessels congested and the gastric tubules distended by granular and fatty material, or by granules mixed with small cells. In the small intestine in some cases the tubules of Lieberkühn were destroyed, and there was an extravasation of blood into the villi. He considered that the stomach epithelium took part in the general desquamation, for in this stage he found large layers and tubular casts of epithelium in the stomach contents.

Wagner found the mucous membrane of the jejunum and ileum, particularly the villi of the former, filled with cells and granules. The epithelial cells of the glands were opaque and fatty.

Klein described two cases in which the epithelium was loosened, and in which a cellular infiltration was present between the tubules in both stomach and intestine. The lymph follicles showed the same changes as the organs of the neck.

Crooke (1885) studied six cases. All showed swelling and hyperemia of the mucous membrane. In one case the lymph follicles were hyperplastic with necrotic centres. The epithelium was fatty, and the muscularis was infiltrated with round cells. He called the condition found in this case an interstitial gastritis.

Stomach. — This organ was examined in six cases. The most marked changes were seen in Case 98–99. The patient died on the second day, and the autopsy was made six hours after death. The surface of the stomach was covered with a thick layer of mucus and necrotic epithelial cells. Everywhere through this mass were numerous polymorphonuclear leucocytes and irregular masses of cocci. The tubular glands, particularly their superficial portions, did not stain well. The parietal cells took a deep eosin stain. In the lumina were numerous polymorphonuclear leucocytes and granular material. The spaces between the tubules were closely packed with enormous numbers of typical plasma cells. Here also were seen many eosinophiles. A few mast-cells were present. Lymphoid cells were not numerous. The plasma cells were most numerous between the superficial portions of the glands, but they were also quite numerous lower down. The eosinophiles were most numerous close to the muscular coat. In the lower part of the mucous membrane were numerous enlarged and altered lymph nodules. They were regular in shape and occupied one-half to two-thirds of the space between the muscularis and the surface of the mucous membrane. In a section one and one-half cm. long, with three rugæ, there were sixteen of these foci. The centres of these areas were paler than the peripheries, owing to the presence of numerous large endothelial cells between the lymphoid cells. Some of these cells had inclusions which were chiefly fragmented lymphoid cells. At the peripheries of the nodules were a few plasma cells.

Four cases, in three of which death occurred on the third, and in one, on the fourteenth day, showed similar but less marked changes. The case which died on the thirty-second day showed no changes of interest.

Intestine. — Both small and large intestine were examined in nine cases, two of which died on the second, and four on the third day, and one each on the eighth, fourteenth and thirty-second days, respectively. The changes were very similar to those in the stomach. The epithelium was very granular and stained poorly. In most cases plasma cells

were present in large numbers between the glands. The lymph nodules were enlarged and in some cases had areas containing large endothelial cells, some of which had inclusions. In cases in which Peyer's patches were very prominent the overlying glands were almost entirely destroyed, only the deeper portions remained intact. There were no distinct ulcerations. Eosinophiles were numerous.

The *appendix* was examined in six cases. Here the changes in the epithelium were not so marked as in the intestine. On the other hand the changes in the lymph nodules were more extensive. The nodules were very large, the centres pale and almost completely occupied by large phagocytic endothelial cells. Plasma cells were numerous between the glands.

Spleen. — Few references to the histology of the spleen of scarlet fever can be found in the literature. Biermer described an enormous enlargement of the Malpighian bodies.

Wagner described an increase of lymphoid elements.

Klein (eight cases) found the Malpighian bodies enlarged. Their centres showed a peculiar pale area composed of endothelial-like cells. In the intima of blood-vessels was a hyaline change, in some leading to degeneration and obliteration of the vessel wall.

Spleen. — Twenty-one cases examined. The histological changes in the spleen may be considered under three heads; changes in the Malpighian bodies; changes in the splenic pulp; changes in the veins.

Malpighian bodies. — In most cases the Malpighian bodies were much enlarged. With a low power the centre of each appeared pale and necrotic, while the periphery stained deeply. With higher power the centre was found to be composed of large endothelial cells, which were so fused together that the periphery of the cells could not be made out. The nuclei of these cells were oval, pale and vesicular. Here and there could be seen an occasional leucocyte or a few darkly staining granules, evidently the remains of fragmented nuclei. The central vessel could not be made out. In two cases true necrosis of these areas was suggested by the presence of leucocytes and an eosin-staining hyaline material. Occasionally, the large cells in these areas were seen to

contain a few lymphoid cells or red blood corpuscles, indicating that they were phagocytic. Outside of the central area the increase in the size of the Malpighian body was largely due to the presence of great numbers of plasma cells. Many of these showed mitotic figures. In some cases in which there was no central area of endothelial cells the increase in size of the Malpighian body was due to an increased number of plasma cells.

Splenic pulp. — The infiltration with plasma cells, although most marked in the corpuscles, was not limited to these bodies. Everywhere through the pulp they could be seen in large numbers. Mitotic figures were common. In some cases plasma cells were very numerous in the blood-vessels, and here also they frequently showed nuclear figures. In one section a plasma cell was seen passing through a vessel wall. Plasma cells were found abundantly in the Malpighian bodies, in lymphatics, around blood-vessels and along the trabeculæ.

Veins. — In regard to the veins, a condition was found in some cases which I cannot find referred to anywhere as either a normal or a pathological condition. This change consists in a collection of cells just beneath the endothelium. The cells were principally plasma and lymphoid cells, with occasionally a few leucocytes. They were generally arranged in irregular rows of two to four cells, but in some vessels were 6 to 10 rows deep, causing irregular projections into the lumen of the vein. This condition was particularly well marked in cases 97–144 and 98–9. In the latter case some of the small veins were almost occluded by these projecting masses of cells. In eight other cases the same condition was found, but in a less degree. It has been demonstrated that plasma cells are found in large numbers, both in the blood vessels and in the splenic pulp. It is probable that plasma cells in the blood-stream have been able to force their way through the endothelium of the vein, but have not been able to penetrate the muscular coat, and as a result have collected between the two tissues. As they accumulate here, the endothelium has become irregularly distended, producing the nodular condition seen in these cases.

It is of interest that in all cases in which there were foci of plasma cells in the kidney the spleen showed a great increase of the same cells; and in four of them the above condition of the blood vessels was found.

Among other conditions of the spleen an increase of polynuclear leucocytes was noticed in a few cases. Eosinophiles were particularly common. Large phagocytic endothelial cells were occasionally noticed. Occasionally a mitotic endothelial cell was seen. In all cases there was much congestion of the blood vessels. In one case (98–34) emboli of cocci were found in small blood vessels.

Lymph nodes. — Klein studied the cervical lymph nodes in eight cases. He found the lymph nodules enlarged. In some, the centres were transparent and composed of large cells, some of which he called giant cells. (In his illustrations they closely resemble the giant cells of tuberculosis.) In the lymph nodules he also found large cells with transparent vesicular nuclei. In the sinuses were small cells and also large granular cells with one or two oval transparent nuclei (endothelial). The mesenteric lymph nodes studied in two cases and the bronchial nodes in one case showed a similar condition, as did also the lymph nodules of pharynx and intestine.

Crooke described in the stomach a hyperplasia of the lymph nodules with central necrosis.

Lymph nodes. — These were examined in twenty cases. In all, the mesenteric, cervical and bronchial nodes were selected, and in some cases the inguinal, axillary and retroperitoneal also. The changes were not constant in all cases. In general they were similar to those in the spleen. The blood vessels were congested. In three cases small hemorrhages were seen. The lymph sinuses were widely dilated and contained many large endothelial cells lying loosely in their lumina. These cells were frequently seen to be phagocytic. The inclusions were generally lymphoid cells and red blood corpuscles, less often polymorphonuclear leucocytes. In some cells the remains of five to twelve partially disintegrated lymphoid cells were found. In one case (97–207) twenty lymphoid cells could be counted in one of these large cells. The inclusions were often granular and fragmented, and usually stained intensely. Included red blood

corpuscles stained poorly. In a few instances mitotic figures were seen in these large endothelial cells. These cells are probably the same as those observed by Klein, who described them as "endothelial-like" cells. In the sinuses were also seen numerous plasma cells. They were also frequently found in the blood vessels, and were quite generally scattered through the substance of the lymph node. In all these situations they exhibited numerous mitotic figures.

The lymph nodules were much enlarged. The centres were pale, owing to the presence of large numbers of closely packed endothelial cells. The boundaries of the cells could not easily be made out. In them an occasional inclusion was seen, generally a fragmented lymphoid cell. Polymorphonuclear leucocytes were not often seen in these areas. Occasionally they were present in small numbers. Outside of these areas they were quite numerous, and were often eosinophilic.

These changes were found not only in the large lymph nodes mentioned above, but also in the minute lymph nodules in the mucous membranes of the respiratory passages, pharynx, stomach and intestines.

In one case small foci of suppuration made up of polymorphonuclear leucocytes, fibrin and cocci were found in the cervical nodes. In case 98–34 in which there was a general infection, with metastatic abscesses in various organs, clumps of cocci were found in several of the vessels.

Liver. — Biermer described the small macroscopic areas, which he found scattered through a liver, as composed of a distinct net-work of connective tissue, with few nuclei, surrounding collections of liver cells. The liver cells showed much finely granular fat.

Wagner described similar areas as composed of a new growth of lymphoid or adenoid tissue and occurring principally in the interacinous connective tissue.

Klein described a fatty change in the liver cells and the presence of lymphoid cells in the interlobular tissue, particularly around the bile ducts. In this last place large granular cells with ovoid, clear nuclei were also seen. The arteries were thickened, the nuclei of the muscular coat increased, and in the intima were hyaline changes.

Crooke found the liver cells coarsely granular and fatty, and in some cases he found a peri-portal interstitial hepatitis characterized by

collections of small round cells. These areas were more common in complicated cases. In a case dying on the twenty-seventh day he found in the portal zone necrotic areas made up of large eosin-staining cells with irregular nuclei between them. In an earlier case he found smaller necrosis. As some of his cases had a tuberculosis of the mesenteric lymph nodes these changes in the liver may have been due to that process.

Lubarsch (1893) reported a case of scarlet fever in which there was some disorganization of the liver substance as the result of hemorrhage. Infarcts in the spleen and kidney were apparently due to emboli of liver cells. In the heart was a patent foramen ovale.

Liver. — Twenty-two cases. With the exception of four cases the changes in the liver were slight. In all cases the liver cells show the degenerative changes common to acute febrile diseases. In four cases there was a distinct fatty degeneration. In seven cases there was extensive fatty infiltration. Cellular infiltration was present around the portal vessels in eleven cases. In five the accumulation was slight. The cells were chiefly lymphoid cells with a few polynuclear leucocytes. In some cases a few eosinophiles and occasionally a few plasma cells were seen. In two cases in which the areas were composed almost entirely of leucocytes there was a general infection with the streptococcus.

In addition to the cells ordinarily found in the blood vessels plasma cells were found in six cases. In one of these cases nuclear figures were observed in plasma cells. Phagocytic endothelial cells were found in the blood vessels in five cases. In four cases they were quite numerous. The inclusions were lymphoid cells, leucocytes and red blood globules. Mitosis of endothelial cells was observed in two cases.

In four cases focal lesions of the liver were found, as follows:

Case 98–99. — The capillaries contain numerous phagocytic cells. Many of the endothelial cells lining the capillaries contain inclusions. Frequently small clumps of phagocytic cells can be found in one or more dilated capillaries. The included liver cells show degenerative changes or complete necrosis. Sometimes the phagocytic cells also show degenerative changes and occasionally fibrin has formed around them.

Case 97–385. — The liver tissue is well preserved, shows evidence of a little edema. The capillaries are moderately distended. Numerous phagocytic cells are present containing red blood globules and polynuclear leucocytes, less often lymphoid cells. Many of the capillary endothelial cells while still attached to the wall show marked phagocytic properties. Mitosis of the capillary endothelium is comparatively common. Occasionally small clumps of phagocytic cells collect in the capillaries, but no distinctly focal areas have yet formed. In the connective tissue around the portal vessels there is an increase of lymphoid cells and occasionally phagocytic cells can be found among them.

Case 98–50. — The centres of the lobules show well-marked congestion. Besides the red blood globules, the elements which appear in the capillaries are numerous polymorphonuclear leucocytes, lymphoid and plasma cells, and large phagocytic cells containing many inclusions. Rarely small groups of these latter cells occlude a capillary. Sometimes the phagocytic cells show hyaline transformations of the protoplasm or even complete necrosis. In the centres of nearly every lobule some of the liver cells are necrotic. Around some of the central veins the necrosis of the liver cells is very marked, around others it is slight. Where the necrosis is marked many of the liver cells show infiltration with polymorphonuclear leucocytes. Many leucocytes are also present between the necrotic liver cells and the capillary endothelium. The capillaries in these areas of necrosis are patent and filled with blood.

Case 97–144. — The focal areas are very distinct, because almost all of the cells within them stain deeply with eosin. The areas vary much in size, but never equal a lobule in area. Usually they are irregularly spherical in shape, but sometimes elongated. They have no definite situation in the lobules, but they occur in any part of them. Most frequently, perhaps, they are near or adjoin the portal vessels. Occasionally, however, they adjoin the central vein. As a rule the outlines of the areas are sharply defined. Under high power the protoplasm of most of the cells appears homogeneous, but occasionally is finely granular. As a rule the out-

lines of the cells are sharp, but sometimes the protoplasm is broken up into irregular lumps, or two or more cells are fused together. Some of the cells have lost their nuclei, in others the nucleus is irregular in outline, stains lightly, and usually does not show any distinct nucleolus. The nucleus is generally situated in the periphery of the cell. Many of the cells contain inclusions. Of these the red blood globules are the most easily recognized. The other inclusions are chromatic masses which stain deeply. Whether they are derived from leucocytes or from lymphoid cells cannot be determined. No pervious capillaries can be found in any of these areas. The capillary walls often show the same hyaline change that is present in the cell protoplasm. Weigert's fibrin stain brings out small masses of fibrin in many of the focal areas. At the edges of these focal lesions, the more or less hyaline degenerated or necrotic cells often interdigitate with columns of liver cells which show more or less evidence of pressure. Aside from the focal areas, single hyaline, degenerated, or necrotic cells are frequently found in the liver tissue. They always lie within capillaries, and often contain inclusions.

No very active reaction seems to have taken place around the focal areas. A little invasion, in places, of the necrotic cells with leucocytes is about all that can be made out.

The focal areas in the livers in these four cases would seem to arise in the same manner as the focal lesions, recently described by Mallory, so often found in the livers of typhoid cases; that is, from endothelial cells derived in part from the capillary endothelium of the liver, in part from embolism through the portal circulation of cells originating in the spleen. It is impossible, of course, to draw any positive conclusions from such a limited number of observations as are herein presented, but the facts above cited certainly are suggestive. Besides the above lesions, Case 98–50 shows, also, well marked necrosis of the liver cells in the centres of the lobules (called central necroses by Mallory, a lesion dependent, probably, on a strong diffusible toxin in the circulation, acting where the circulation is slowest, and in this case, at least, where the amount of blood is greatest.)

Myocardium. — In nine cases, in which the heart muscle was teased and examined after treatment with acetic acid, a fatty degeneration was demonstrated in five.

In seven cases, which number includes the five mentioned above, the myocardium was studied after hardening in Zenker's fluid. The tissue for examination was taken from the interventricular septum and from the papillary muscles. In two of the cases, in which death occurred on the second and fourteenth days respectively, no change was observed. In two dying on the third and eighth days respectively, the muscle fibres appeared granular and the striations were not so distinct as usual. In one case there was slight edema of the intermuscular connective tissue. In two cases which died on the second and thirty-second day respectively, the granular appearance of the fibres was very marked. The normal striation in places was lost entirely. Some of the fibres were shrunken, others were broken transversely. The spaces between the fibres were widened and contained a finely granular substance, often arranged in a reticulum, similar to that sometimes seen in the tubules of the kidney. The fragmentation was not marked. It occurred as frequently through the body of the cell as in the cement line and evidently resulted from degenerative changes. In these two cases the post-mortem examination was made six and twelve hours, respectively, after death. It seems improbable, therefore, that the changes were entirely post-mortem.

In another case, however, which died on the second day, and in which the fragmentation was very extensive, the autopsy was not made until forty hours after death. In this case the striation of the fibres was distinct, there was no granular change, and the fracture was practically always through the cement substance. In this case, at least, the changes would appear to be post-mortem.

Various views have been held in regard to segmentation and fragmentation of the myocardium. Some investigators consider it a definite affection of the fibres with distinct clinical symptoms, and state the causes as being alcoholism, infection, senile changes and high temperature. Others consider the changes to take place during the death agony. Still others consider them to be post-

mortem. Recent investigations, however, would seem to indicate that they are not due either to post-mortem changes or to artefacts.

Among recent investigators Hektoen (1897), after a study of 190 cases, believes that it may occur in the normal heart muscle as the result of excessively vigorous and irregular contractions. More frequently, however, it is associated with acute and chronic, secondary and primary myocardial changes, that alter the cement substance, weaken the plasma, and predispose to disassociation under normal or increased heart's action. He does not consider the existence of primary segmentation as a distinct disease to have been proved.

MacCallum (1898), after a study of the embryonic development of the heart muscle, and of the changes occurring in fragmentation of the myocardium, believes that the changes in the latter include two processes: *First*, a break, either through the body of the cell or in the cement line, resulting from a degeneration of the plasma; and, *second*, a simple break, the mechanical result of the unusual strain thrown on the undegenerated fibres.

The lung. — Was examined in fifteen cases. The only cases of interest were those (eight) in which a broncho-pneumonia was present. These were studied particularly in regard to the presence, in the exudate, of plasma and phagocytic cells. In all, plasma cells were present. In some cases they were not numerous, in others very abundant. In most cases they were more abundant in the alveolar wall than in the exudate; in the former location they were found grouped around the blood vessels. Often they were found in the vessels. Mitotic figures were very numerous, and were observed often in cells within vessels. In the alveoli they were found in small numbers mixed with the other elements of the exudate.

In Case 98–34, in which metastatic abscesses were present in the lung, the centres of the abscesses were made up of pus cells and necrotic material, while at the periphery were immense numbers of plasma cells.

A few large phagocytic endothelial cells were found in the exudate in four cases. The inclusions consisted of lymphoid cells, red blood corpuscles, and occasionally a polymorphonuclear leucocyte.

Blood-clots from the right side of the heart were examined in two cases which died on the second and third days respectively. In addition to the polymorphonuclear leucocytes

and lymphoid cells, plasma cells were found. In the first case they were quite numerous, but in the second they were scarce.

The bone-marrow (femur). — Was examined in eleven cases. With the exception of two adults aged eighteen and twenty-seven the bone marrow was taken from children aged from two to ten years. In all cases the bone marrow was very cellular; this condition was less marked, however, as would be expected, in the two adults. It was most cellular in the cases two and three years old. There was but little difference in this respect in cases from four to ten years of age. Giant cells and nucleated red blood corpuscles were seen. Eosinophilic cells were exceedingly numerous, anywhere from six to twenty could be counted in a single field. They had either a dark staining round nucleus, or a polynucleus. The granules stained intensely, and were rather coarse. The protoplasm surrounding them was not sharply defined. Lymphoid cells and neutrophilic leucocytes were seen in fair numbers.

The principal cell seen, however, in all cases was about the size of and closely resembled the plasma cell. It had a round or slightly oval nucleus, containing irregularly placed chromatin granules, staining intensely. This nucleus was surrounded by considerable finely granular protoplasm which stained a light blue or sometimes pinkish blue. The nucleus was generally eccentrically placed, either at one side or at one end of the cell. These cells were generally round, but sometimes elongated or irregular in their outline. In them nuclear figures were commonly observed. These cells were found either singly or grouped together in small masses. Occasionally they were found within blood-vessels. They formed the bulk of the cells found in the bone marrow. Owing to the impossibility of obtaining the normal bone-marrow of a child for comparison, it is impossible to draw any conclusions in regard to these cells.

The thymus gland. — This organ was examined in five cases. In three, nothing unusual was found; in the other two large numbers of phagocytic cells were found. These cells were very numerous in both cases.

In one case, a child aged nine years, who died on the third day of the disease, the inclusions were entirely lymphoid cells. Most cells contained from eight to fifteen, but in some twenty could be counted. In the other case a child aged two years, who died on the second day of the disease, the phagocytic cells were equally numerous, but red blood corpuscles as well as lymphoid cells could be found among the inclusions. There were also numerous large endothelial cells without inclusions. In both cases, but particularly in the latter, large numbers of eosinophilic cells were found. The large phagocytic cells bore no relation to the epithelial bodies (Hassal's bodies) present in the gland.

As far as I am aware histologists do not mention the presence of these large cells. They may have a physiological relation to the atrophy which takes place naturally in this organ; that is, it may be through these cells that the lymphoid elements of the gland are taken up and either digested or carried to other parts of the body. Against this is the fact that in the other three cases (five, six and fifteen years old respectively) no evidence of phagocytosis was found.

That it may be but a part of the general process of scarlet fever, as seen in the lymph nodes and spleen, seems probable. To definitely settle this point a large number of cases must be studied.

Pancreas. — A slight inflammatory condition of this organ was described by Fenwick.

Klein (two cases) found collections of lymphoid cells around the veins.

Pancreas. — In this series the pancreas was examined in four cases with negative results.

Salivary Glands. — Klein (three cases) described collections of lymphoid cells around the veins.

Salivary glands. — In this series the salivary glands showed but slight changes. The cells were normal, or slightly more granular than normal. In the connective tissue in some cases a few lymphoid cells and polymorphonuclear leucocytes were found.

The *other organs* examined were the suprarenal capsule, thyroid body, mammary gland, urinary bladder, testicle, uterus, brain, pituitary body and pineal gland. These organs were either normal, or showed slight changes in no way connected with scarlet fever.

Kidney. — Biermer (1860), in a child five and a half years old dying of scarlet fever, found kidneys which were large, swollen and pale. Small white specks the size of hemp seeds were scattered through the cortex near the bases of the pyramids. Microscopically, these areas were composed of small, closely packed stellate cells. This is probably the earliest description of an acute interstitial nephritis associated with scarlet fever.

Wagner (1867) described a large, lax kidney, with grayish streaks, in which were punctate hemorrhages. Microscopically, these streaks were composed of circumscribed collections of cells, grouped particularly around the glomeruli. He compared it to a "lymphatic new growth in the kidney," and considered it one of the four forms of acute renal disease in scarlet fever and typhoid. In both these cases the only other change in the kidney was a granular condition of the epithelium.

Kelsch (1874) in a general review of nephritis mentioned acute interstitial nephritis as the typical lesion of scarlet fever. He described the cells as being of an embryonic character, closely packed together, particularly around the glomeruli.

Coats, in the same year, described a case of acute interstitial nephritis in a case dying on the tenth day. He described an infiltration with round cells, most marked in the cortex. The tubular epithelium was granular. He compared the microscopic appearance to that of the leucemic kidney. He considered the cells to be derived in part from leucocytes and in part from proliferation of the connective tissue cells.

Thomas (1875) described circumscribed or diffuse areas resembling abscesses and composed of small round cells. The kidney as a whole presented the appearance of interstitial or purulent nephritis. He considered catarrhal nephritis as most common, but stated that capsular changes or abscess formation might occur.

Klebs (1876) divided the changes into three groups:

1. In the febrile stage, a granular desquamation of the epithelium.

2. Towards the end of the disease an acute interstitial nephritis is common. The kidneys are large, lax, and on section smooth, with grayish white nodules. Microscopically the tubules are granular or fatty, and the tissue between infiltrated with lymphoid cells. He believed that these cells came from the vessels.

3. During convalescence, a glomerulo-nephritis.

Phisalix (1877) claimed that the nephritis of scarlet fever was not marked by parenchymatous changes, but by an interstitial infiltration of round cells.

Bohn, in the same year, stated that an acute parenchymatous nephritis was the characteristic kidney lesion of scarlet fever.

Wagner (1880) stated that during the rash there might be slight histological changes in the kidney; but the more common change was after the third week, when the vessels were congested, the tubular epithelium granular, and the spaces between the tubules and particularly around the glomeruli filled with small round cells. He called this a "lymphomatous nephritis," and said he had not seen the glomerulo-nephritis of Klebs. Microscopically the kidney was large, swollen, easily torn, and on section there were found grayish white, irregular flat areas corresponding to the cellular infiltration.

Waller, in the same year, stated that interstitial foci were common in post-scarlatinal nephritis, that fibrous tissue might be formed from them, producing as a final result a chronic contracted kidney.

Leyden (1881) considered that the acute nephritis of scarlet fever was of the parenchymatous variety, but that foci of small cell infiltration with small hemorrhages were frequently found between the tubules and around glomeruli. In some cases there might be a capsular proliferation.

Ribbert, in the same year, found glomerular lesions not only in acute scarlatinal cases, but also in sub-acute and chronic cases.

Litten (1882), apart from fatty degeneration and hemorrhage, considered the most common lesion to be an inflammatory round cell infiltration of the interstitial tissue. In two late cases he found proliferation of the capsular epithelium with compression of the glomeruli.

Fischl (1883) agreed with Friedländer's observations, particularly in regard to glomerular changes, but described also an interstitial round cell infiltration most marked around the affected glomeruli and around small vessels.

Cornil and Brault (1884) described an acute interstitial nephritis occurring in the course of scarlet fever.

Namerck (1884) considered the initial changes to be limited to the epithelium. Later, there might occur cellular increase in glomeruli, and proliferation of capsular epithelium, with small cell infiltration of the labyrinth and about small veins. These cells arose by emigration, but might be added to by proliferation of the fixed connective tissue cells.

Crooke (1885) considered the changes of the first week to be glomerular and catarrhal in character, while from the thirteenth to the sixty-eighth day interstitial changes were common. The latter condition he found in fifteen cases.

Grauer (1887) agreed with Friedländer's classification. He reported nine cases of glomerular nephritis occurring in the course of scarlet fever, and considered it the characteristic renal lesion of the disease. He found a hypertrophy of the left ventricle in all glomerular cases.

Obrzut (1888) considered the glomerular lesions to be the most important. Both tuft and capsule might be affected.

Litten (1890) agreed with Friedländer's classification.

Sorenson (1891) considered all the different forms as stages of one process; the degenerative, interstitial and glomerular changes went together; the interstitial lesions were more marked in the early, and the glomerular in the late cases. In three of his cases the interstitial changes were markedly prominent.

Delafield (1891) stated that scarlet fever is characterized by acute exudative nephritis and by acute productive or diffuse nephritis.

Van Kahlden (1892) agreed with the classification of Friedländer and Litten. He considered the second or interstitial form to be more common in septic cases or those complicated by diphtheria. He also thought it probable that the second and third forms might develop from the first.

Langhans (1893) studied twelve cases. He described changes in the tubular epithelium, and a slight degree of cellular infiltration in the walls of small veins and around the glomeruli. He had not seen the large interstitial kidney.

Baginsky and Stamm (1893), in a study of twenty-four cases, found no distinct changes for stated periods of the disease; but in twelve cases dying during the first week there was more or less extensive interstitial infiltration with round cells. These were either focal or diffuse. In cases dying during the second and third weeks, acute parenchymatous nephritis, with slight capsular changes, was noticed. In three of these cases there were metastatic abscesses. After the third week both the interstitial and the glomerular forms were found; the latter was the more common.

Rosenstein (1894) regarded the capsular form of glomerulonephritis as the most essential. He thought that the large interstitial kidney of Friedländer was rare, but admitted that slight focal accumulations of cells might be found around the vessels.

Turner (1894) found the glomerular form rare, and the interstitial form common. In the former, interstitial changes were often noticed.

Aufrecht (1894), in three cases, found extensive accumulations of round cells about the glomeruli. He believed the interstitial process to be a lesion of the blood vessels, characterized by the accumulation of round cells not only in the kidney, but also in the liver and spleen.

Councilman (1897), in a study of acute and sub-acute nephritis, described three cases of pure interstitial nephritis occurring in the course of scarlet fever. In this study he claimed that the cells arose from the fixed cells of the connective tissue, particularly from the endothelium of small veins and capillaries. Later (1898), in a study of acute interstitial nephritis, he changed his opinion in regard to the cells to the view that the foci were made up mainly of Unna's plasma cells, with a few phagocytic endothelial cells and a few leucocytes. According to him the plasma cells emigrate from the blood-vessels and undergo mitosis. Nuclear figures were common. He observed these cells passing through the vessel wall, and, from their variation in shape, believed them to possess ameboid motion. He claimed that they were derived from lymphoid cells, and that the change to plasma cells took place, probably, in the spleen.

In regard to chronic renal lesions, resulting from the acute changes of scarlet fever, several observations have been made. Waller (1880) believed that the cellular accumulations of the acute interstitial process might become organized, form fibrous tissue, and produce a chronic contracted kidney.

Leyden (1887) reported a case in which a nephritis, developing during the convalescence of scarlet fever, resulted fatally in three years. The post-mortem examination showed a chronic contracted kidney and cardiac hypertrophy. The lesions, microscopically, were most marked in the glomeruli.

Handford (1890) reported a case of chronic diffuse nephritis, with marked fibrous changes, in a girl, twelve years old, who three years before had scarlet fever, with acute renal symptoms.

4. KIDNEYS.

Gross appearances. — In six cases cloudy swelling was noted. Two cases with acute interstitial nephritis were suspected from the gross appearances of the kidneys. In one, a boy aged eighteen years, the kidneys weighed 360 grammes. In the other, a girl aged four years, they weighed 190 grammes. In the latter case the kidneys appeared large and swollen. The capsule peeled readily, leaving a smooth watery surface. On section the cortex was swollen, the surface was mottled with small grayish, translucent areas which were most numerous in the intermediate zone and in the adjoining cortex. These areas were irregular, round, or linear in shape. They were present in less degree in the cortex immediately beneath the capsule. Here and there small hemorrhagic areas could be seen.

The kidney of the first case showed the same condition, but in a less marked degree. In the kidneys of this case there were also several small metastatic abscesses.

With the exception of the above cases the gross appearances of the kidneys in this series were of little interest.

Histological examination. — Of eight cases in which an examination was made in the fresh state, six showed a more or less marked fatty degeneration. Twenty-three cases were examined after hardening in Zenker's fluid. All showed acute degenerative changes. The epithelium was abnormally granular, and in some cases showed distinct cloudy swelling. Some tubules stained very poorly; the lumina contained a circular reticulum, and in a few cases fine hyaline casts were found. The blood vessels were much congested. In no cases were glomerular changes found.

Acute interstitial nephritis was the important lesion. In four cases (97–144, 97–339, 98–34 and 98–135) the process was very extensive, and in five other cases it was slight. In the former, the cellular infiltration was most marked in the cortex just beneath the capsule, around the glomeruli and around the blood-vessels in the intermediate zone. The cellular areas were made up chiefly of plasma cells, with a few lymphoid cells and leucocytes. Many nuclear figures were noted in plasma cells. In the straight vessels of the pyramids, plasma cells, some of them mitotic, could be seen. The glomeruli were unaffected. Degenerative changes were not more marked in these cases than in those having no interstitial infiltration. In one case (98–34), where diffuse suppuration of the scalp was present, multiple metastatic abscesses were found in addition to the plasma cell infiltration. These cases were fatal on the eighth, ninth, fourteenth and fifteenth days, respectively.

In five other cases a few small foci of plasma and lymphoid cells were found just beneath the capsule. In two of these cases they were also found around vessels of the intermediate zone.

Of these cases three were fatal on the third, one on the twelfth, and one on the sixteenth day.

In two cases in which no definite foci could be found the straight vessels and the vessels of the intermediate zone contained numerous plasma and lymphoid cells.

5. GENERAL SUMMARY.

No light can be thrown on the etiology of the disease. The only constant gross change is a hyperplasia of the lymphoid tissue in every part of the body. The anatomical points on which a clinical diagnosis is based (appearance of skin, tongue and palate) are not usually seen post-mortem. A false membrane on the tonsil occasionally may be seen.

The micro-organisms producing secondary inflammatory lesions are the streptococcus pyogenes, the staphylococcus pyogenes aureus, and the pneumococcus. They are named in the order of the frequency of their occurrence. The streptococcus is also found most frequently in the cases with general infection and on the mucous membrane of the throat and nose.

The more important inflammatory complications observed in these cases in the order of their frequency are: acute broncho-pneumonia, acute inflammation of the middle ear with or without extension to the mastoid cells; suppuration of cervical lymph nodes; acute pleuritis; and inflammation of the antrum of Highmore. The less frequent complications are abscess of the lung, ulceration and abscess formation in the upper respiratory tract; acute endocarditis; inflammation of the sphenoidal sinus; and metastatic abscesses of the kidney.

Of the above complications, inflammation of the antrum of Highmore is the most interesting. In the literature at my disposal I can find only one reference [1] to the bacteriological examination of these cavities in scarlet fever. This is probably due to the fact that these cavities are seldom examined in this disease.

A study of the complications in this series of fatal cases, forcibly illustrates the fact that the infections of the middle

[1] Wolff (1895) reports the examination of both antra in two cases of scarlet fever. In one an inflammatory condition was present, and the staphylococcus pyogenes aureus and bacillus pyocyaneus were obtained in cultures. In this case there was also an inflammatory edema of the sphenoidal sinus. No culture. In the second case there were no inflammatory changes, and cultures were sterile.

ear, antra of Highmore and of the sphenoidal sinuses are of the utmost practical importance. They are present in scarlet fever in a large percentage of cases, and in the cases which do not terminate fatally they may be the source of chronic processes detrimental to the health of the patient.

The histological examination of the skin, tongue, and mucous membrane of the mouth and pharynx, shows the changes here to be inflammatory as well as vaso-motor. The blood vessels are congested, the lymphatics dilated, and the epithelial and sub-epithelial tissues, particularly the former, infiltrated with polymorphonuclear leucocytes. The changes are most marked in the tongue.

The lesions in the *gastro-intestinal* tract consist of degenerative changes in the epithelium and of proliferative and degenerative processes in the lymph nodules, similar to those in lymphoid tissue elsewhere.

The changes in the heart muscle are fatty degeneration and fragmentation.

Two forms of focal lesions may occur in the liver; the first is due to accumulations of phagocytic cells in the capillaries leading to occlusion of the vessels and necrosis of the included liver cells; this lesion may occur in any part of the lobule. The other is due to a necrosis of liver cells in the centres of the lobules, followed by an infiltration with leucocytes.

The changes in the spleen consist of a proliferation of the endothelial cells in the centres of the Malpighian bodies and of the endothelial cells lining the blood sinuses. In the lymph nodes a similar proliferation takes place in the lymph nodules and lymph sinuses. These newly-formed cells are generally markedly phagocytic. There also occurs in the spleen and lymphoid tissue generally an abundant formation of plasma cells from lymphoid cells. Mitosis is frequent.

From a study of the kidneys of these cases it would appear that acute interstitial nephritis is the most important renal lesion of scarlet fever. It was well marked in four cases dying late in the second, or early in the third week of the disease. No glomerular lesions were found. This may be explained by the fact that of the cases examined only one

died after the sixteenth day. Glomerular lesions occur late in convalescence.

The most marked cell change in scarlet fever is the production of plasma cells in the spleen, lymph nodes and lymphoid tissue generally throughout the body. In certain cases these cells are present in large numbers in the circulation, and may emigrate into the tissues of the kidney and lung. This process is analogous to the one mentioned by Councilman as occurring in diphtheria. A less frequent cell change is the production of phagocytic cells from the endothelium of lymphoid tissue generally, and from the endothelium lining the lymph sinuses of the lymph nodes, and the blood vessels of the spleen and liver. This proliferation of endothelial cells, although not so marked, is analogous to the general proliferative process described by Mallory as occurring in typhoid fever.

Whether the proliferation of plasma and endothelial cells is due to the toxin of scarlet fever, or to that of secondary infecting organisms, cannot be definitely stated. In all cases, except one, secondary infections were present. In more than half the cases, however, death occurred on the second or third day, before the complications were far advanced. This would indicate that the toxin of scarlet fever proper is the important agent.

6. Appendix of Cases.

Case 96–13. — Male, two and one-half years old. Temperature 105°, broncho-pneumonia of both lungs. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute broncho-pneumonia; acute general lymphatic hyperplasia.

Bacteriological Examination. — Lung, staphylococcus aureus and the streptococcus pyogenes; other organs sterile.

Case 96–37. — Female, three and one-half years old. Temperature 104.5°. Urine negative. Pneumonia of right lung with pleurisy. Died on the sixteenth day after appearance of eruption.

Anatomical Diagnosis. — Acute broncho-pneumonia; acute mitral endocarditis; acute general lymphatic hyperplasia.

Bacteriological Examination. — Cultures from liver, kidney and mesenteric lymph node — streptococcus; lung, streptococcus and staphylococcus aureus.

Case 97–96. — Female, four years old. Temperature 104.5°. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute general lymphatic hyperplasia.

Bacteriological Examination. — Liver and kidney, streptococcus; spleen sterile.

Case 97–144. — Female, five years old. Temperature 105°. Stomatitis. Urine showed slight trace of albumen. Died on fourteenth day after appearance of eruption.

Anatomical Diagnosis. — Ulceration of œsophagus; multiple miliary necrosis of liver; acute general lymphatic hyperplasia; open foramen ovale; acute interstitial nephritis.

Bacteriological Examination. — Heart's blood, liver, spleen and kidney, streptococcus.

Case 97–145. — Male, eleven months old. Temperature 102°–104°. Acute otitis media. Died on sixth day after appearance of eruption.

Anatomical Diagnosis. — Empyema of left chest; atelectasis of left lung with remains of abscess cavity; open foramen ovale; acute general lymphatic hyperplasia.

Bacteriological Examination. — Liver, colon bacillus; spleen, pneumococcus; kidney, sterile; left pleural cavity, streptococcus and pneumococcus; lung abscess, streptococcus and pneumococcus.

Case 97–158. — Male, one and one-half years old, admitted April 23, fading rash of scarlet fever, glandular enlargement, axillary abscess, abdomen distended, tympanitic and tender, particularly in region of umbilicus. Pulse poor and compressible, 120–140. Temperature 100–101°. Died on the seventh day after appearance of eruption.

Anatomical Diagnosis. — Acute general peritonitis following acute inflammatory process in a Meckel's diverticulum; acute bronchopneumonia.

Bacteriological Examination. — Heart and liver, sterile; spleen and kidney, colon bacillus; abdomen, variety of organisms, colon bacillus prominent.

Case 97–169. — Male, three years old. Urine negative. Temperature 102.5°, irregular, rising to 104–105°. Died on tenth day after appearance of eruption.

Anatomical Diagnosis. — Desquamation of scarlet fever; fatty degeneration of liver; double purulent mastoiditis; anasarca; hydrothorax; hydroperitoneum.

Bacteriological Examination. — Heart's blood, liver and spleen, sterile; kidney, colon bacillus; right and left mastoid, variety of bacilli, staphylococcus albus prominent; lung, staphylococcus pyogenes aureus and pneumococcus.

Case 97–207. — Female, nine years old, eruption hemorrhagic. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Subcutaneous petechial hemorrhages; acute ulcerative tonsillitis; acute cervical adenitis; acute general lymphatic hyperplasia; acute broncho pneumonia; acute inflammation of both middle ears; fatty degeneration of liver.

Bacteriological Examination. — Heart's blood and spleen sterile; lung, staphylococcus pyogenes aureus and streptococcus; trachea, variety of organisms, aureus and streptococcus abundant; liver, left middle ear, brain and cervical lymph nodes, streptococcus; mesenteric lymph nodes and kidney, staphylococcus pyogenes aureus, streptococcus and colon bacillus; right middle ear, pneumococcus.

Case 97–209. — Female, six years old. Temperature 105°. Died on third day after the appearance of eruption.

Anatomical Diagnosis. — Acute ulcerative tonsillitis; acute general lymphatic hyperplasia; acute suppuration of right middle ear.

Bacteriological Examination. — Heart's blood, liver, spleen and brain, sterile; tonsil, variety of organism, streptococcus prominent; kidney, colon bacillus; right middle ear, staphylococcus.

Case 97–241. — Male, thirteen years old. Temperature 102–105°. Died on the third day after the appearance of the eruption.

Anatomical Diagnosis. — Acute tonsillitis and pharyngitis; multiple small abscesses of œsophagus; acute splenic tumor; chronic adhesive pleurisy; congestion of lungs, parenchymatous degeneration of liver and kidneys.

Bacteriological Examination. — Heart's blood, spleen and brain, sterile; liver and kidney, colon bacillus; lung, streptococcus and staphylococcus pyogenes aureus.

Case 97–269. — Female, seven years old. Temperature 105°. Urine negative. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute cervical adenitis; acute general lymphatic hyperplasia; acute splenic tumor; congestion of lungs.

Bacteriological Examination. — Heart's blood, lung and kidney, streptococcus; liver, spleen and brain, sterile; cervical lymph node, staphylococcus pyogenes aureus.

Case 97–279. — Female, twenty-seven years old, eruption on back hemorrhagic. Temperature 104°. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute catarrhal inflammation of both middle ears; acute general lymphatic hyperplasia; acute splenic tumor.

Bacteriological Examination. — Heart's blood, streptococcus; spleen, sterile; kidney, streptococcus and colon bacillus; middle ear, sterile.

Case 97–324. — Male, seventeen years old. Temperature 103–105°. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute general lymphatic hyperplasia; acute splenitis; sub-pleural and sub-pericardial hemorrhages; acute interstitial nephritis.

Bacteriological Examination. — Heart's blood, liver and spleen, sterile; kidney, staphylococcus pyogenes aureus and colon bacillus.

Case 97–339. — Male, two and one-half years old. Temperature 100°; edema of face around the eyes. Dermatitis of right side of face. Stomatitis. Died on ninth day after appearance of eruption.

Anatomical Diagnosis. — Edema of subcutaneous tissues of neck; edema of larynx; double acute confluent broncho-pneumonia; acute purulent bronchitis; acute general lymphatic hyperplasia; acute splenitis; acute suppurative inflammation of both middle ears; granulating operation wound of right side of neck.

Bacteriological Examination. — Heart's blood, right and left middle ears, streptococcus; liver, spleen and kidney, colon bacillus.

Case 97–385.— Female, twenty-one years old. Admitted December 17. Had never been ill before. On December 13, had a normal labor. On the 14th became feverish, pain over abdomen, headache, and developed a rash. On admission showed marked prostration, had septic odor and was semi-conscious. Skin over anterior aspect of thighs, on trunk and arms showed a bright red punctate eruption. Tongue had a thick yellow coat with elevated and much reddened papillæ at tip, congestion of tonsils, uvula and palate. No membrane. Bright punctate eruption on hard palate. Pulse weak; heart sounds irregular and weak. Marked corneal congestion of both eyes. Dark, foul-smelling discharge from vagina. Abdomen distended and firm on pressure. Uterus curetted, and pieces of membrane with much foul discharge removed. Temperature 104°. December 18. Pulse cannot be felt, profuse foul discharge from vagina, delirious. Temperature 106°. Died fifth day after appearance of eruption.

Anatomical Diagnosis. — Acute diphtheritic endometritis; acute general lymphatic hyperplasia; acute splenitis; adenoma of thyroid body; fatty degeneration of heart and kidney.

Bacteriological Examination. — Heart, liver, spleen and kidney, sterile; uterus, variety of organisms, streptococcus and colon bacillus prominent.

Case 97–396. — Female, age six years. Died on twelfth day after appearance of eruption.

Anatomical Diagnosis. — General subcutaneous petechial hemorrhages; acute sero-fibrinous pleuritis; acute general lymphatic hyperplasia; suppurative inflammation of both middle ears; empyema of both antra of Highmore and of sphenoidal sinus; fatty degeneration of heart, liver and kidney. Edema of lungs.

Bacteriological Examination. — Pleuritic exudate, streptococcus; heart's blood, liver, spleen and kidney, sterile; sphenoidal sinus and antra of Highmore, staphylococcus, pyogenes, aureus and albus and bacillus pyocyaneus.

Case 98–9. — Female, age three years. Temperature 102.4° to 104°. Urine, slight trace of albumen. Died on fourteenth day after appearance of eruption.

Anatomical Diagnosis. — Acute ulcerative tonsillitis; adenoids of post pharynx; empyema of both antra of Highmore; acute suppuration of both middle ears; hydropericardium; subcutaneous ecchymoses.

Bacteriological Examination. — Heart's blood, liver, spleen and kidney, negative; right and left antra of Highmore, variety of organisms, streptococcus pyogenes, staphylococcus aureus and albus; middle ears, streptococcus; nasal cavity, abundant staphylococcus pyogenes aureus and albus.

Case 98–34. — Male, age eighteen years. Admitted February 3 (second day of illness). Chills, prostration, angina; tongue, skin and throat show characteristic eruption of scarlet fever.

February 3d, 4th, and 5th, urine showed slight trace of albumen. Temperature 103–104°; pulse 120 to 140. On fourth day developed an erysipelas of right side of face. Pain in left hip and wrist. Wrist tender and swollen, and on sixth day an acute middle ear. February 8th, delirious. February 9th, erysipelas worse, pain in right ear. Died February 10th, on eighth day after appearance of eruption.

Anatomical Diagnosis. — Desquamation of scarlet fever; acute fibrino-purulent pericarditis; acute fibrinous pleuritis; embolic abscesses of lungs and kidneys; acute general lymphatic hyperplasia; acute splenitis; mucoid accumulation in right antrum of Highmore and both middle ears; erysipelas of right side of face and scalp; fatty degeneration of heart and liver.

Bacteriological Examination. — Heart's blood, liver, and kidney, staphylococcus pyogenes aureus and the streptococcus; pus from scalp, and pericardial exudate, staphylococcus pyogenes aureus; right lung, staphylococcus pyogenes aureus and streptococcus.

Case 98–50. — Female, colored, age six years. Temperature 102°. Urine showed slight trace of albumen. On fifth day developed whooping-cough. On twenty-ninth day developed a broncho-pneumonia. Died on thirty-second day after the appearance of eruption.

Anatomical Diagnosis. — Acute broncho-pneumonia; fatty degeneration of kidney and heart.

Bacteriological Examination. — All cultures sterile after forty-eight hours.

Case 98–99. — Female, age two years. Temperature 102.6°. Died on second day after appearance of eruption.

Anatomical Diagnosis. — Acute broncho-pneumonia; acute general lymphatic hyperplasia.

Bacteriological Examination. — Cultures sterile.

Case 98–153. — Male. Temperature 104°. On eleventh day cervical abscess opened. Died on fourteenth day after appearance of eruption.

Anatomical Diagnosis. — Acute bronchitis, acute broncho-pneumonia; atelectasis of lung; acute splenitis; acute interstitial nephritis; acute general lymphatic hyperplasia.

Bacteriological Examination. — Heart's blood and spleen, streptococcus; liver, sterile; kidney, staphylococcus aureus, colon bacillus.

Case 98–227. — Male, five years old. Died on second day after appearance of eruption.

Anatomical Diagnosis. — Acute general lymphatic hyperplasia; atelectasis of lung; acute bronchitis; parenchymatous degeneration of liver and kidney.

Bacteriological Examination. — Heart's blood, liver, spleen and kidney, sterile.

Case 98–242. — Male, three and one-half years old. Died on third day after appearance of eruption.

Anatomical Diagnosis. — Acute tonsillitis.

Bacteriological Examination. — Negative.

REFERENCES.

Aufrecht. Deut. Arch. f. Klin. Med., lii., 339, 1894.
Baginsky und Stamm. Arch. f. Kinderheilk., xvi., 350, 1893.
Biermer. Virchow's Archiv., xix., 537, 1860.
Bohn. Gerhardt's Handb. d. Kinderkr., ii., 258, 1877.
Bourges. Gaz. hebd. de méd., Paris, 2s., xxviii., 146, 1891.
Burckhardt-Merian. Volk. Samml. klin. Vorträge. Chir., 1880.
Coats. Brit. Med. Jour., 400, 1874.
Cornil et Brault. Paris Thesis, 1884.
Councilman. Med. and Surg. Reports, Bost. City Hosp., 1897.
Councilman. Jour. Exper. Med., iii., 4 and 5, 1898.
Crooke. Fortsch. d. Med., iii., 651–662, 1885.
Crookshank. Trans. Lond. Path. Soc. xxxix., 1888.
Deiter. Quoted by Thomas, Ziemssen's Handbuch.
Delafield. Trans. Assoc. Amer. Phys., vi., 1891.
Delafield and Prudden. Path. Anat. and Hist., 4th edition, 1892.
Dunin. Virchow's Arch., xciii., 287, 1883.
Ehrlich. Berl. klin., Woch., s. 927, 1898.
Fenwick. Med. Chir. Trans. London, xlvii., 209, 1862.
Fischl. Ztschr. f. Heilk., iv., 1–25, 1883.
Foot. Dublin. J. M. S., lvi., 264, 1874.
Friedländer. Fortschr. der Med., i., 49, 1883.
Gluck. Arch. f. Kinderheilk., xvi., 382, 1893.
Goodhart. Trans. Lond. Path. Soc., xxxi., 1880.
Grauer. Med. News., l., 16–19, 1886.
Handford. Trans. Lond. Path. Soc., xli., 1890.
Harley. Med. Chir. Trans. London, lv., 103, 1872.

Hektoen. Amer. Jour. Med. Sciences, cxiv., 555, 1897.
Huguenin. Pathol. Unters. Zurich, 1869.
van Kahlden. Zeigler's Beiträge, xi., 1892.
Kaposi. Lehrbuch der Hautkrankheiten.
Kelsch. Arch. de phys. norm. et path., 2d serie, i., 722, 1874.
Klaman. Allg. med. Centr.-Ztg. Berl., liii., 1349, 1883.
Klebs. Handb. Path. Anat., i., 632, 1876.
Klein. Local. Gov. Reports, viii., 24. London, 1876.
Klein. Trans. Path. Soc. Lond., 1877.
Langhans. Virchow's Arch., xcix., 193, 1893.
Lemoine. Bull. et. mem. Soc. Med. d. hop. de Paris, 3 s., xii., 847; also xiii., 1896.
Leyden. Deutsch. Med. Woch., xiii., 589, 1887.
Leyden. Zeitschr. f. klin. Med., iii., 1881.
Litten. Charité Annalen, vii., 128.
Litten. Charité Annalen, iv., 179, 1882.
Litten. Berl. klin. Woch., 261, 1890.
Lubarsch. Fortsch. der. Medicin. Band, xi., 1893.
Mallory. Jour. of Exper. Med., iii., No. 6, 1898.
McCallum. Johns Hopkins. Hosp. Bull, ix., No. 89, 1898.
Nauwerck. Zeigler's Beiträge, i., 1884.
Netter. Arch. de Med. Exper. et d'Anat. Path., iv., 1892.
Neumann. Medix. Jahrbücher, 159, 1882.
Nothnagel. Specielle Path. u. Ther., iv., Band, ii., Vienna, 1896.
Obrzut. Rev. de Méd., 1888.
Orth. Lehrb. Path. Anat., ii., 628-632.
Osler. Practice of Medicine, 3d edition, 1898.
Phisalix. Paris Thesis, 1877.
Pohl-Pincus. Allg. med. Centr. ztg. Berl., liii., 1145, 1883.
Queissner. Jahr. für Kinderk, 1889.
Remy. Progrès Med., Paris, viii., 959, 1880.
Ribbert. Nephritis und Albuminuria. Bonn., 1881.
Rosenstein. Path. d. Nierenkrankheiten, 3 aufl., s. 42, 1894.
Seitz. Munch. Med. Woch., 1898, No. 3.
Simon. Die Hautkrankheiten. Berlin, 1851.
Sorensen. Zeit. f. klin. Med., xviii., 298, 1891.
Thomas. Ziemssen's Cycl. of Pract. of Med., Amer. ed., vol ii., 1875.
Tüngel. Virchow's Archiv., vol. 16, p. 360.
Turner. Guy's Hosp. Reports, li., 173.
Unna. Die Hist. der Hautkrankheiten. Hirschwald, 1894.
Wagner. Archiv. d. Heilkunde, 1867, 263.
Wagner. Ziemssen's Handbuch, ix., 143.
Wagner. Deutsch. Arch. f. klin. Med., xxv., 529, 1880.
Waller. Jour. Anat. Phys., xiv., 432, 1880.
Wolff. Ztschr. f. Hygiene u. Infect., xix., 1895.
Wright. Bost. Med. and Surg. Jour., March 21, 1895.

DESCRIPTION OF PLATES I AND II.

PLATE I.

Fig. 1. Bone-marrow, showing cells resembling plasma cells; also numerous eosinophiles, of which the granules alone can be seen.

Fig. 2. Mucous membrane of stomach, showing enlarged lymph nodule, with pale centre composed of large endothelial cells.

Fig. 3. Centre of necrotic focus in liver, showing necrotic cells, leucocytes and detritus.

Fig. 4. Edge of necrotic focus in liver.

Fig. 5. Tongue, near tip, showing infiltration of epithelium and papillæ with polymorphonuclear leucocytes.

Fig. 6. Tongue, showing the marked infiltration of the superficial epithelium with polymorphonuclear leucocytes.

PLATE II.

Figs. 7 and 8. Veins of spleen showing collections of lymphoid and plasma cells beneath endothelium.

Fig. 9. Higher power of same condition seen in Figs. 7 and 8.

Fig. 10. Kidney, showing focal area of plasma cells.

Fig. 11. High power of Fig. 10.

Fig. 12. Kidney, showing lymphoid and plasma cells in vein of intermediate zone.

Plate I.

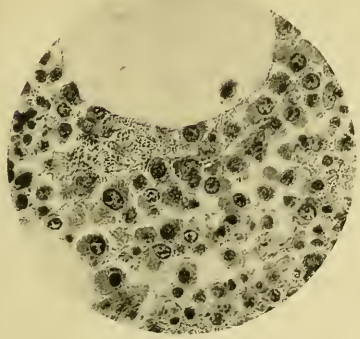


Fig. 1

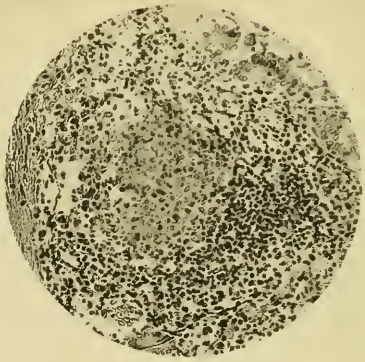


Fig. 2

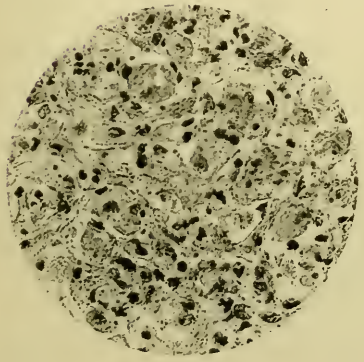


Fig. 3

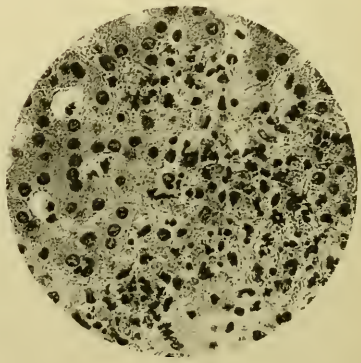


Fig. 4

Fig. 5

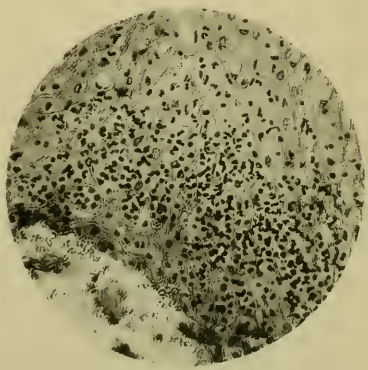


Fig. 6

Plate II.

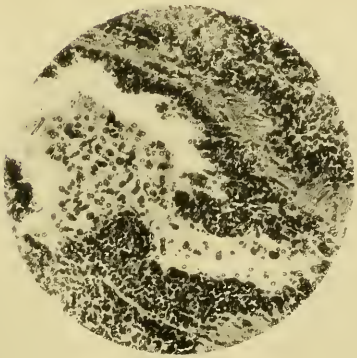


Fig. 7

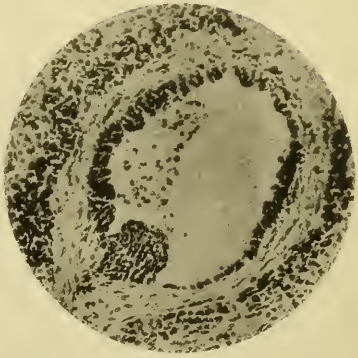


Fig. 8

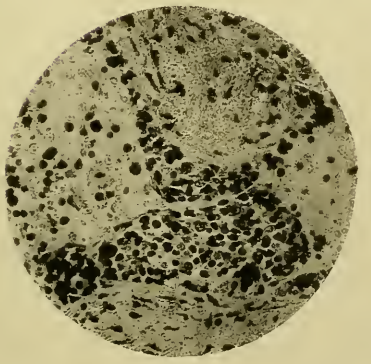


Fig. 9

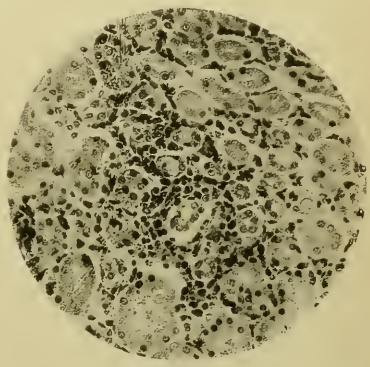


Fig. 10

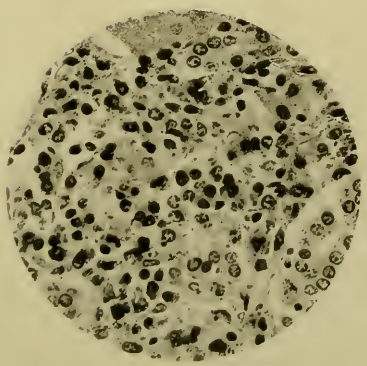


Fig. 11

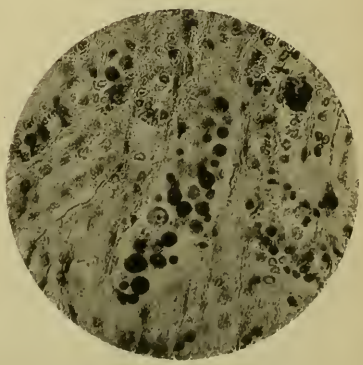


Fig. 12

III.

OBSERVATIONS ON THE WEIGHT OF THE "NORMAL" HEART IN ADULTS IN 216 CASES.

By Horace D. Arnold, M.D.

In carrying out a line of investigation as to the condition of the heart in cases in which autopsies had been performed at the Boston City Hospital, the writer found it advisable to study, as a preliminary step, the conditions which obtain in apparently normal hearts. It has seemed worth while to record the results of this preliminary investigation.

The weight of the heart is the most important point to be considered in determining whether or not hypertrophy exists, and to what extent it exists. The measurement of the thickness of the heart-wall is the next best means of determining this question. The thickness of the wall, however, varies according to the state of contraction of the muscle which is found post-mortem, and this fact, and the fact that the wall of any one cavity varies in thickness in different parts, and furthermore, the difficulty of determining just how much to include under the head of thickness of the wall, owing to the anatomical relations of the papillary muscles, — these facts make the thickness of the heart-wall a more or less unsatisfactory basis for comparison.

On the other hand, the weight of the heart as a whole does not enable us to judge which *part* is affected by hypertrophy. This important point may be determined by measurements of the thickness of the wall, of the dimensions of the cavities, and of the size of the orifices. Valuable observations have also been made by some observers by weighing separately that part of the muscle which constitutes the wall of each individual cavity. But as observations of this

character have not been made in our autopsies this matter need not be considered here.

In limiting our inquiry to the consideration of the weight of the heart I have been influenced somewhat by the material at hand, the weight of the heart having been very generally recorded in the autopsy records of late years, whereas the systematic record of other measurements has only been undertaken more recently.

Previous to May 1, 1894, the weight of the heart was not generally recorded in "normal" cases, so I have begun my study of autopsies at this point. All autopsy records have been critically examined up to November 10, 1898. Only cases from the age of puberty upwards have been considered, the youngest being fourteen years of age. Only those cases have been included that died in the hospital proper, as the cases from the contagious department were so largely children that the few adult cases did not give sufficient data for drawing any satisfactory conclusions as to the condition of the adult heart in persons dying of contagious diseases.

The selection of cases to be included under the head of "normal" hearts has been to some extent an arbitrary one. I have excluded all cases in which dilatation or hypertrophy is noted, all cases in which the valves were affected, and all cases in which the myocardium was noticeably affected. In all cases the clinical history has been taken into consideration as well as the pathological record, and this has often determined whether a given case should be included in this series or not. For example, when in a case of acute lobar pneumonia a slight condition of cloudy degeneration of the myocardium is noted, or a degree of fatty degeneration so slight that the microscope alone reveals it, or when there has been a slight increase in the amount of pericardial fluid, or even a slight degree of fresh pericarditis — all clearly secondary to the acute pneumonia and of too short duration to have had any appreciable effect on the weight of the heart — in such cases the heart has been included in this series.

When, however, these same conditions have been marked, or of any long duration, the case has been excluded. In

regard to fatty degeneration of the myocardium I made it the rule to exclude all cases in which it was marked enough to be observed macroscopically, and also those cases in which the microscope showed marked fatty degeneration, whether observed macroscopically or not. To exclude all cases in which a slight degree of fatty degeneration was demonstrated only by the microscope would seem an unnecessary refinement, and could not be carried out for the whole series, as the systematic microscopic examination of the heart muscle for fatty degeneration was not carried out in the earlier cases.

Causes for exclusion lying outside the heart itself include pathological conditions of the kidneys and blood vessels. In many of these cases I am convinced that the changes were not of a degree to have affected the heart, but it seemed best to leave all such cases for some future inquiry as to what effect these diseases have in causing heart hypertrophy. Here again a certain amount of arbitrariness was necessary in deciding doubtful cases.

In regard to degenerative changes in the kidneys, practically the same rule was adopted as in the case of the myocardium, that is, only those cases were included in which the changes were very slight and were clearly attributable to an acute disease (outside the kidney) of short duration. Cases of acute pyelitis in which the duration was short and the parenchyma of the kidney was not noticeably affected were not excluded.

In regard to the arteries, all cases were excluded in which arterio-sclerosis or any other degenerative change was noted in the anatomical diagnosis; also all cases in which any noticeable degree of arterio-sclerosis was found in the description of the arteries even if not considered of importance enough to note in the summary of the case. I have also excluded those cases in which the clinical records showed that the peripheral vessels were affected, though the autopsy showed the aorta and large vessels to be normal.

There are included in this series a few cases in which a few minute specks of arterio-sclerosis were found in one or another portion of the aorta. To have excluded all of these

would have practically deprived me of statistics above a certain age. But no cases are included in which even this slight degree of arterio-sclerosis was widely distributed.

I believe that in considering the causes of heart hypertrophy the question of the elasticity of the blood vessels is of fully as much importance as the degenerative changes shown in the intima, and that the latter changes are not always a true index of the amount of change in elasticity. But, as there are no statistics available on this point in the cases under consideration, the topic cannot be considered.

With these limitations, 216 cases were found which may fairly be included under the head of "normal" hearts. I purposely avoided excluding any cases on account of the weight alone. It is probable that some of the heavier hearts are really somewhat hypertrophied. But as no apparent cause for hypertrophy was found in the records, and as there was no cause for exclusion except the weight itself, it would seem like begging the question to assume, when trying to determine the weight of normal hearts, that everything above a given arbitrarily determined weight was abnormal.[1] The heaviest heart included in the series weighed 385 grammes.

Again, at the other extreme, some of the hearts are so light as to make it obvious that there was more or less atrophy. These, however, have been retained, partly for the same reasons for which the heavier hearts were retained; partly, too, because one of the objects in view is to determine the effect of general diseases on the heart, when neither the heart itself, nor the kidneys, nor the circulatory apparatus are involved as essential parts of the disease.

Strictly speaking, then, we ought not to apply the term

---

[1] Prof. W. T. Councilman has kindly called my attention to a case which illustrates the limits which may be reached in the weight of the heart in health. This individual was a young man, who died in twenty-four hours from an acute infection, having previously enjoyed perfect health. He was an athlete, well developed and very muscular. His height was 6 feet 4 inches; his weight, 240 pounds. The heart weighed 480 grammes. In the relative proportion of its various parts to each other, and of the whole heart to the body, it appeared perfectly normal. This certainly is a very unusual heart, though not an abnormal one. As an example of the extreme limit of a normal heart-weight, it shows that that limit cannot be set arbitrarily. On the other hand, it cannot be called "normal" in the sense of representing the average, any more than the individual who possessed it could be called an average man in development

"normal" to these cases. A strictly normal person or organ is a rarity, especially when it reaches the pathological table. It would be more correct to speak of the "natural" heart, the heart as found in a person of average health, of a given age, sex, build, and development. To determine the weight of the "natural" heart, and to see how it is modified by diseases not immediately connected with the circulatory system is the object of our present inquiry.

Authorities differ widely in their estimates of the weight of the normal heart. This is not difficult to understand. The heart is a muscular organ, and like other muscular tissue, increases and diminishes to a certain extent, according to the amount of work it is called upon to do. It also shares to some extent the good or poor nourishment of the body in general.

While the problem of the heart is in some respects unique, partly owing to its peculiar structure and partly to the fact that a certain minimum amount of constant, unremitting work is absolutely necessary for the continuance of life, still it is affected within certain limits like other organs by comparatively slight causes, provided they are persistent. Many elements thus enter as factors which may modify the weight of the heart, besides those due to such diseases as are recognized as exerting a marked effect upon it. These influences differ in degree rather than in kind from those acting as a result of disease.

It is undoubtedly due to causes of this nature that the weight of the heart differs in different localities. I quote the following from Howard's article on Heart Hypertrophy in the Johns Hopkins Hospital Reports, Vol. III., page 267: "Thus, observations made in Munich, the same methods being used, show that the Munich heart is considerably larger than the Berlin heart. Observations made in London give a different result from those made in Berlin. Observers in Paris give the normal heart weight as less than observers in either Berlin or London. From our own observations we would conclude that the Baltimore heart weighs less than the Berlin heart, and very much less than the Munich heart." The present inquiry is concerned with the Boston heart.

It is difficult to demonstrate just what these differences in weight are due to. Probably several influences combine to bring about the result, of which the most important is undoubtedly the variation in the amount of work the heart has to do. It has been demonstrated that the heart is increased in weight in some occupations which require excessive muscular exertion, and it is probable that the amount of muscular work habitually required in a man's occupation is one important factor in determining the weight of his heart. It also seems clear that the habitual use of alcohol in sufficient amounts affects the heart, though it is not so certain just how this is brought about.

It is known that the male heart is heavier than the female heart, that the weight varies with the age, the size of the body, and the muscular development. The heart-weight is also said to have a definite relation to the length of the body. All these conditions which modify the weight of the heart are consistent with good health and are not dependent on any pathological change.

The heart-weight is shown by Peacock to be greater in those dying of acute disease than in those who have succumbed to some chronic wasting disease. It is quite likely that different conditions of nutrition within the limits of health, if they are permanent or prolonged, have an effect on the heart-weight.

Thus it is easy to understand how in a given series of cases the predominance of one or more of the above factors might modify the results obtained, even when the same methods were employed in weighing the hearts and the same care was exercised in the selection of cases which are called "normal."

However, one of the chief causes for the difference in the estimates given by different authors is, I am convinced, the difference in the care exercised in the selection of cases. It is unfortunate that in the largest single compilation, that of Boyd, comprising over 2,000 cases of all ages, all autopsies were used without reference to the cause of death or the nature of the pathological changes. Several writers have not separated the sexes in reporting the weights.

Particularly in the tabulations made in the first half of this century it is not uncommon to find cases included which were acknowledged to have died of kidney disease, or else cases in which the weight given for the kidneys showed there must have been some pathological change in these organs. This is true of a number of cases in Clendinning's tables, and to a lesser degree of the statistics by Peacock.

Even after the importance of excluding kidney diseases was appreciated, it was not recognized that arterio-sclerosis was an important factor in its effect on the heart-weight. Thoma has especially called attention to this point. The statistics of earlier writers showed that the heart-weight increased steadily during the whole of life up to the age of seventy or eighty years. Thoma calls attention to the fact that after the age of thirty to thirty-six years all the other organs diminish somewhat in weight, and he thinks that the observation that the heart continues to increase in supposedly normal cases may probably be due to the fact that the importance of arterio-sclerosis was overlooked.

Oppenheimer, in statistics from birth up to twenty-five years of age, shows that the heart increases during this period of most rapid growth in about the same ratio as the other organs of the body. The other organs continue to increase with it up to thirty to thirty-six years of age. It is certainly significant that in the years which follow, when arterio-sclerosis is so commonly developing, the heart breaks away from a relation it has previously held to the other organs as regards growth.

Howard states that arterio-sclerosis is the most common cause of heart-hypertrophy outside the heart itself after thirty years of age. He reports that 80 per cent. of the cases of arterio-sclerosis have heart-hypertrophy, that of his 105 reported cases of heart-hypertrophy 62 or 59 per cent. had arterio-sclerosis, and that of all the cases of general hypertrophy of the heart 77.6 per cent. had arterio-sclerosis.

Thoma has furnished a table compiled from previous writers, having excluded, as far as information was given, all unsuitable cases. This table is of special value, both on account of the number of cases included and on account of the care in

the selection of the cases. It may be regarded as a summary of the work done in this line up to the date of its publication, 1882.

The summary of his table is given in connection with the present article for the purposes of reference and comparison, and also as a check on deductions drawn from our own cases alone, which are after all rather limited in number. [See Table A.]

The following summary of the estimates of a number of writers illustrates the difference in their estimates of the weight of the normal adult heart. When given in ounces it has been reduced to grammes for purposes of comparison, the following figures indicating grammes:

Henle. — Males, extreme limits 198 to 425.
Mean weight, 283. Weight in males one-sixth more than in females.

Lobstein. — 255 to 283. (Age and sex not given.)

Cruveilhier. — 213 to 244. (Both sexes; 16 years and upwards.)

Senac. — 227 to 283. (Age and sex not given.)

Bouillaud. — 225 to 255; may be 283 to 300.

Clendinning. — Males, 258. Females, 210. (21 to 60 years.)

Reid. — Males, 303. Females, 255. (25 to 55 years.)

Peacock. — 20 to 50 years.

	Acute Diseases.	Chronic Diseases.
Males.	255–300.	225–283.
Females.	225–283.	198–255.

Small delicate persons with emaciating disease, sometimes 140 to 170.

Large powerful males, may be 340 or over.

Accidental death:

Blosfeld. — Males, 346. Females, 310.

Dieberg. — Males, 346. Females, 340.

Coming now to the consideration of our own cases, we have 216 cases from the age of fourteen upwards. All cases from the autopsy records were taken in which the data were sufficiently full to be of service, with the exception of those excluded for various reasons as already mentioned. The heart-weight is the essential point under consideration. In

determining the weight the method has been to cut the blood vessels close to the heart, thus freeing the heart from the parietal pericardium and all but the very beginning of the arterial trunks. The heart is then opened, the clots and blood are removed, and it is then weighed.

Besides the heart-weight I have noted the following facts as having a possible bearing on the question at issue — sex, age, length of body, occupation, cause of death, and the condition of development and nourishment of the body whenever it has been noticeably above or below the average. There were so few negroes among these cases that it was not thought worth while to take note of the race question, especially as the weight in the few cases found did not differ apparently from similar white cases. It is to be regretted that the facilities of the pathological laboratory are not such as to permit the weighing of the whole body. For the absence of the body weight deprives us of an important factor in judging of the significance of variations in the heart weight.

TABLE A.

PERIOD.	THOMA'S TABLE.		MALES.		FEMALES.	
Years.	No. of Cases.	Average Weight in grms.	No. of Cases.	Average Weight in grms.	No. of Cases.	Average Weight in grms.
15–20	51	233.7	12	264	7	196
20–30	164	270.6	41	277	25	251
30–40	300	302.9	33	297	19	267
40–50	243	303	31	297	21	256
50–60	225	316.6	9	317	8	246

Average: 134 males = 290 grammes.
82 females = 253 grammes.

The results of the investigation are shown in five tables. Table A shows the variations according to sex and age, grouped in ten-year periods. It also includes the summary of Thoma's table for purposes of comparison. It will be noted that Thoma does not separate the cases according to sex. This is not because he did not attach importance to

such a division, but because such a classification was not made by some of the investigators from whom he drew his statistics.

Our table confirms the generally accepted fact that the male heart is heavier than the female. The average of our male and female cases combined would come quite near Thoma's figures in younger adult life, but would fall quite a little below his figures for the later periods. The more accurate investigation as to the existence of arterio-sclerosis in the autopsies upon which our table is based will probably account satisfactorily for this difference, which becomes noticeable just at the age when arterio-sclerosis is becoming a frequent occurrence.

Our table shows for the male heart a fairly steady increase in weight from 264 grammes for the period from 14 to 20 years up to 317 grammes for the period from 50 to 60 years. For the female heart there is a similar increase from 196 grammes for the earliest period up to 267 grammes for the period from 30 to 40 years; in the next two decades the weight falls off, reaching 246 grammes in the last. There is no obvious explanation for this difference between the male and female heart between the ages of 40 and 60 years. It is possible, too, that if statistics were available for a larger number of cases this peculiarity of the female heart might not be found to be a constant one.

The average weight of 134 male hearts was 290 grammes, and of 82 female hearts was 253 grammes. These averages are made from all the cases, 216 in number. Table A, however, includes only 206; two being over 60 years of age and eight not having the age given.

Table B.

Sex.	Pneumonia.		Sudden.		Typhoid Fever.		Other Acute.		Chronic.		Chr. Pulm. Tuberculosis.		Chronic c. Wasting.	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
Males ..	28	313	8	296	22	285	43	287	11	284	13	281	9	251
Females	13	289	2	220	10	271	29	253	6	258	14	227	8	221

Summary.

Sex.	Total Average.		Total Acute.		Chronic.		Total Wasting.	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.
Males	134	290	101	295	11	284	22	269
Females.....	82	253	54	264	6	258	22	225

Table B deals with the question of the modification of the heart-weight by disease within the so-called "normal" limits. The degree to which the heart may thus be influenced could be better estimated if we had more reliable information as to the exact weight in health. This could best be obtained from cases of perfectly healthy persons who have come to a sudden death by violence. I have been unable, however, to find any reliable statistics for any large number of such cases. It must be borne in mind that cases of sudden or violent death do not necessarily occur in healthy people alone.

The effect of acute and chronic diseases on the heart has been already discussed by some writers. Clendinning is the earliest writer on this subject to whose work I have had access. He claims that "the weight of the heart increases with years up to the end of life, contrary to the laws of nutrition of the viscera in general." He also concludes from statistics of some cases of phthisis that the heart is likewise unaffected when other organs are affected, as a result of general diseases. The continued increase in the weight of the heart in the latter part of life we have already considered in connection with arterio-sclerosis, to which it is probably due. His arguments based on his phthisis cases were shown to be fallacious by Peacock, both by a more critical analysis of Clendinning's own tables, and also by more extensive tables of his own. So Clendinning's argument in favor of the view that the heart is independent of influences which might affect other organs was proved unsound.

Peacock called attention to the fact that "the weight of the healthy heart differs in different forms of disease; being greater in persons dying after short periods of illness, less in those who have suffered from protracted and emaciating

disease." With this general statement, the statistics of our cases in Table B are in accord. He goes on, however, to say about phthisis cases that, while the heart-weight is less than in those who have died of acute diseases, it is not so much diminished as in chronic diseases which are not associated with disease of the lungs. His explanation is that in phthisis there is obstruction to the passage of blood through the pulmonary circulation, hence increased work for the heart, and hence a tendency to increase in weight, which partially offsets the loss that would otherwise come from such a chronic wasting disease.

In our tables the figures for phthisis are somewhat less than those for ordinary chronic affections, and not so small as those for other chronic but distinctly wasting diseases, of which cancer is the commonest representative in our table. I do not feel, therefore, that our evidence in regard to cases of phthisis indicates clearly anything different from what would be expected of any disease of equal chronicity and emaciation. Notwithstanding Peacock's excellent work on the heart, I do not feel convinced that we ought on the present evidence to accept his conclusions in regard to the phthisical hearts. One of my reasons is that the progress of medicine requires us to-day to make a more critical selection of cases than it required him to make forty-five years ago. On the other hand, our own statistics are too few for our conclusions to be accepted as final. It should be noted, too, that where pulmonary disease has caused hypertrophy of the right ventricle the case has been excluded from our series as one of hypertrophy.

A general survey of our cases suggested that the duration of the disease, and the amount of wasting, were factors of great importance. Consequently, chronic diseases accompanied by wasting were separated from other chronic diseases, and these in turn from acute diseases, making three general heads. Further subdivision was made when the number of cases of a single disease was sufficiently large. Thus pneumonia and typhoid fever were separated from other acute diseases, and chronic pulmonary tuberculosis from other chronic wasting diseases. Cases of sudden death, from accident, suicide, etc., were grouped under a separate heading,

in the hope that they might give a better idea of the normal heart uninfluenced by disease. The number of cases, however, is so small that deductions are unsafe. Furthermore, some of them were far from representing the normal average of men or women. For example, the two female cases were small and poorly nourished. They had committed suicide, and it is likely that want and privation may have played as important a rôle as disease does to reduce the heart-weight.

Leaving the group of sudden deaths out of account, as being unsafe for generalization, we find the weights for ordinary acute diseases corresponding pretty closely to the average weights of the whole series. The shorter acute diseases have greater weights in proportion to the shortness of the disease, while the diseases of longer duration, especially those accompanied by wasting, show a decrease in weight proportioned to the duration and the amount of wasting. We may conclude, then, that the heart-weight varies inversely as the duration of the disease, and diminishes directly with the amount of wasting which accompanies the disease.

A further consideration of the facts shown in our table would suggest that the weight of the true normal heart would be found as high as the weight given in our table for pneumonia, if not higher, and that the effect of all diseases which do not mechanically increase the work of the heart is to diminish the heart-weight to some extent.

It is suggestive, in this connection, that Blosfeld and Dieberg, who both drew their statistics from cases of accidental death, place the normal heart-weight higher than any other writers: 346 grammes for males and, respectively, 310 and 340 grammes for females. I could not get access to their writings to determine with what care the cases were selected, and whether they might fairly be called average people in good health.[1]

[1] Since writing the above I have found a statement of interest in this connection in Hamilton's Text-book of Pathology. London, 1889. After emphasizing the importance of selecting only the healthy individuals who had met accidental death, he gives the results of the examination of twenty-seven males and four females. His results (changed here from ounces to grammes) show the male hearts ranging from 283 to 450 grammes, and the females from 200 to 440 grammes. The commonest weights for males were from 340 to 368 grammes, and for females from 283 to 312 grammes. This evidence tends, as far as it goes, to confirm the view that the true normal heart-weight is considerably above the average of our table.

The effect of an emaciating disease upon the heart-weight was very clearly shown in the cases of four soldiers who had returned from the Santiago campaign in the late war. The result is all the more remarkable because the diseases were of comparatively short duration. In all four cases there was an extreme condition of emaciation. The cause of death in one was typhoid fever, in another it was amebic dysentery, in the third malaria and dysentery, and in the fourth ulcerative colitis, phthisis, and pneumonia. The ages ranged from 18 to 24 years, with an average of 21 years. According to Table A, the "normal" weight for this age is about 270 grammes. Instead of this we find the weights in these cases, respectively, 215, 185, 180 and 215 grammes, with an average of 199 grammes. We have, then, in these cases an average loss of about 70 grammes, as the result of disease of not very long duration, but accompanied by extreme emaciation. The fact that all recruits were obliged to pass a physical examination would make it a safe assumption that these individuals started in average health with a heart-weight at least up to the average of 270 grammes. We could not have a better illustration to prove that a general disease *does* have an effect upon the heart-weight.

TABLE C.

DISEASE.	Sex.	Total.		Muscular and Obese.		Emaciated.	
		no.	wt.	no.	wt.	no.	wt.
Acute	Males	101	295	11	337	13	256
	Females	54	264	7	320	4	240
Chronic	Males	11	284	3	333	1	235
	Females	6	258	.....	.....	1	210
Wasting	Males	22	269	1	325	15	249
	Females	22	227	.....	.....	12	210
Total	Males	134	290	15	335	29	251
	Females	82	253	7	320	16	217

Table C shows an attempt to ascertain what relation exists between the heart-weight and the body-weight. It is only a rough estimate, for the body-weight is not given. Those cases were selected in which the muscular development, obesity, or emaciation was considered worthy of special note at the autopsy as distinctly outside the ordinary limits. The cases are first compared with reference to the three groups of Table B, and then with the averages for the whole series. It is clearly shown that in especially heavy persons the average heart-weight is decidedly greater than it is for the average person with the same condition of disease, while in especially light persons the heart-weight is correspondingly light. While thus showing a general correspondence between the heart-weight and the body-weight our statistics do not warrant the assertion that there is a constant relation between heart-weight and body-weight, though the probability of such relation is suggested.

Some writers have said very positively that there is a definite relation between the heart-weight and the body-length. The body-length was noted in ninety-two of our cases. These cases failed to show any definite relation whatever between the heart-weight and the body-length. It must, therefore, be accepted that the body-length is not in itself a safe guide to the heart-weight, or else it must be assumed that these ninety-two cases represented very exceptional conditions. It was found not only that a steady increase in length of body was not accompanied by a corresponding increase in heart-weight, but that there were very wide variations in weight for any given height. For example, ten males with a body-length between 175 and 180 centimetres had hearts varying in weight from 180 to 365 grammes. In other words, the heaviest heart weighed a little more than twice as much as the lightest for the same length of body.

TABLE D.

Occupation of Males.

	Cases.	Grammes.
Indoor occupations	26	272
Average occupations	46	284
Laborers	20	296
Teamsters and coachmen	9	298
Extra heavy occupations	12	334
Total	113	Average, 290

Table D classifies the cases according to occupation. Only the male cases were thus classified, the occupation of the females being monotonously stated as "housework," without indicating the amount of labor involved. The following cases were excluded: seventeen cases in which the occupation was not stated, and four soldiers recently returned from Cuba, where great emaciation and a very light heart-weight clearly indicated exceptional conditions. This leaves 113 of the 134 males to be classified by occupation.

First those cases were selected which had an extra laborious occupation. The average weight in these twelve cases was 334 grammes, considerably above the average of 290 grammes. Next the general class of laborers was taken, with an average of 296 grammes, only slightly above the general average. Teamsters and coachmen formed the only other group, with a large enough number to have the occupation considered separately. Their average was 298 grammes, about the same as laborers. The other cases were divided into two groups, those with an indoor and sedentary occupation and those whose occupation involved an "average," but not very great, amount of labor. The table shows a gradual increase in the average heart-weight for these various groups, corresponding to the amount of labor involved, thus showing a definite relation between the heart-weight and the amount of labor involved in the occupation.

An excessive and constant use of alcohol was noted in sixteen males and four females. These cases give an average heart-weight of 313 grammes for the males and 285 grammes for the females. While these averages are about 25 grammes higher than the general average of either sex, the number of cases is so small as to make one hesitate to draw any definite conclusions. We ought to exclude five of the male cases on account of extra laborious occupation, leaving eleven cases with an average of 309 grammes. The evidence, as far as it goes, is in line with the statement frequently made that the constant use of alcohol increases the heart-weight, though individual cases were found where this did not seem to be true.

It has thus been demonstrated that a number of factors are at work to influence the weight of the heart, and it is shown that the heart is affected by comparatively slight influences, provided they are persistent. Having determined what these influences were, it was then possible to exclude certain cases as abnormal. In this way a revised average was obtained, and it was demonstrated that practically all cases beyond certain limits were abnormal.

TABLE E.

WEIGHT IN GRAMMES.	150 to 200.	200 to 225.	225 to 250.	250 to 275.	275 to 300.	300 to 325.	325 to 350.	350 or over.
Males	4	7	12	20	30	28	19	14
Females.....	10	15	16	12	11	14	2	2

Revised average weight: Males = 290 grammes.
Females = 260 grammes.

A further help in determining the limits of the variations in the weight of the "natural" heart is furnished by Table E, where the number of cases for a given weight is given.

By these means we have arrived at the following conclusions in regard to the weight of the "natural" heart:

The average weight for males is 290 grammes.

The average weight for females is 260 grammes.

The normal variations are, for males from 250 to 325 grammes, and for females from 225 to 300 grammes.

Weights for 25 grammes outside these limits *may* be "normal;" beyond that they are almost certainly abnormal.

Summary.

Schema. — To consider all cases where the heart was apparently normal, and in which neither disease of the heart, kidneys or blood vessels existed; to see whether other diseases than these had any effect on the heart-weight; to see what other conditions may affect the heart-weight, and to learn the average weight of the "normal" heart.

Conclusions.

I. The heart is affected in weight by comparatively slight influences, provided they are persistent. The effects are not unlike those on other organs, peculiarities of structure and function being considered.

II. The heart in males is heavier than in females.

III. The heart-weight varies with the age, showing a steady increase up to maturity. After that the female heart diminishes somewhat in our statistics, while the male heart continues to increase. No explanation of this difference in the action of the male and female heart can be offered as yet. In all cases over forty years the condition of the arteries with reference to arterio-sclerosis and the elasticity of the walls needs special consideration.

IV. The heart is modified by general diseases, and is not independent of them. The weight in acute diseases is greater than in chronic diseases, the duration of the disease and the amount of emaciation being especially important factors.

V. While the exact relation between the body-weight and the heart-weight cannot be stated from our statistics, it is shown that in large, well-developed, and well-nourished people the heart-weight is considerably above the average, while in poorly-nourished and emaciated people it is decidedly below the average.

VI. In our statistics no definite relation is shown between the body-length and the heart-weight.

VII. The occupation has an influence upon the heart-weight, varying with the amount of labor which the occupation involves.

VIII. The continued use of alcohol in large amounts seems to have some effect in increasing the heart-weight, but this effect is not constantly demonstrated.

IX. The average weight for males is about 290 grammes; the average weight for females is about 260 grammes. The normal variation in males is from 250 to 325 grammes; the normal variation in females is from 225 to 300 grammes. Weights for 25 grammes outside these limits *may* be normal; beyond that they are almost surely abnormal.

X. Our statistics are almost wholly derived from cases of disease. Statistics are desirable from cases of healthy individuals who have met sudden death by violence. These are more likely to give the true weight of the "normal" heart, properly so-called, and it is surmised that this weight is likely to be higher than that already given.

References.

Clendinning. Facts and Inferences Relative to the Condition of the Vital Organs and the Viscera in General as to Their Nutrition in Certain Chronic Diseases. By John Clendinning, M.D. Medico-Chirurgical Transactions. Medico-Chirurgical Society of London. Vol. xxi., 1838.

Peacock. On the Weight and Dimensions of the Heart in Health and Disease. Monthly Journal of Medical Sciences, Edinburgh. Vol. xix., 1854.

Howard. Heart Hypertrophy: An Analysis of 105 Cases of Heart Hypertrophy. From the Autopsy Records of the Johns Hopkins Hospital. By William T. Howard, Jr., M.D. Johns Hopkins Hospital Reports. Vol. iii., 1893.

Thoma. Untersuchungen über die Grösse und das Gewicht der Anatomischen Bestaudtheile des Menschlichen Körpers im Gesunden und im Kranken Zustande. Von Dr. R. Thoma. Leipzig, 1882.

Oppenheimer. Ueber die Wachthümsverhältnisse des Körpers und der Organe. Von Dr. Carl Oppenheimer. Zeitschrift für Biologie. B. xxv., 1889.

Thoma and Oppenheimer give full bibliographies with their articles.

IV.

BONE TUMOR IN THE HUMAN BRAIN SURROUNDING ENCYSTED COCCIDIA OVIFORMIA.

By John Jenks Thomas, A.M., M.D.

The case reported in this paper is presented because of its pathological importance and its rarity.

The patient, Nellie S., entered the Boston City Hospital on February 15, 1898. She was forty years of age, single, a native of Ireland, and by occupation, a domestic servant. The family history was unimportant, though the patient's mother died of phthisis. The patient herself had had measles and small-pox when a child; bronchitis fifteen, and influenza seven years ago. She had been in the habit of using stimulants to excess. She was admitted to the hospital with symptoms of five days' duration, which were those of a neuritis. The symptoms were pain, weakness and paresthesia in the legs. The sphincters were not affected. Examination at entrance showed weakness of the arms and legs, more marked in the latter, with slightly diminished sensation in the legs, and loss of the knee-jerk. The examination at this time showed nothing else except a few râles in both lungs at the bases. The urine was normal in color, acid in reaction, of a specific gravity of 1.020, and contained neither albumin, nor sugar. During the patient's stay in the hospital there developed considerable tenderness to pressure over the nerve trunks, and the patient became tremulous. Later pneumonia developed. On March 9 the temperature, which had been normal up to that time, began to rise, and remained in the neighborhood of 100° until the night of the 15th, when it was 97.4°. The morning of the 16th it was 101.0° and in the evening 102.2°. On the morning of the 17th it was 102.2°, and in the evening 103.0°.

On the morning of the 18th the temperature reached 104.0°. The patient died at 11.45 A.M. of the 18th. The clinical diagnosis was alcoholic neuritis and pneumonia.

The autopsy was on March 18, 1898, six hours after death. The autopsy report is as follows:

The left pupil is smaller than the right. The right pleural cavity is completely obliterated by fresh fibrinous adhesions. The layers of the pleura can be separated, and there are numerous spaces, formed by the meshes of the fibrin, filled with small collections of fluid, which is clear and straw-colored. Smears from this fluid show pus cells, fibrin, and elongated diplococci. The heart muscle shows the presence of much fat. The left lung is normal. The entire surface of the right lung is covered by a fresh fibrinous exudate. The middle lobe shows an irregular area of consolidation, which on section is not particularly granular, but is firm, and shows considerable hemorrhage. The lower lobe is compressed and airless, but there is no consolidation. The spleen weighs 180 grammes. It is dark red in color; capsule smooth; on section, the Malpighian bodies are not visible, and the pulp is slightly increased.

The gastro-intestinal tract is normal.

The liver weighs 1,500 grammes. It is dark red in color; the capsule smooth; substance firm; markings not distinct.

The kidneys together weigh 330 grammes. The capsule peels smoothly. The relation between the cortex and the pyramids is normal. There is a slight cloudy appearance of the cortex, and fresh sections show the presence of much fat.

The brain weighs 1,450 grammes. The membranes are normal. The anterior central convolution is distinctly atrophied, the sulcus on either side being greatly widened. The atrophy extends along the convolution for a distance of about 5 cm. At the upper part of the convolution, about 1.5 cm. from the median fissure, there is a raised, rough, calcareous area about the size of a small pea. The convolution behind this shows slight atrophy.

Cultures: heart, colon bacillus; kidney, sterile; lung, staphylococcus aureus, streptococcus, and a paired coccus, flattened and not lanceolate.

The microscopical examination of sections from the spleen, liver, kidney and lung showed nothing remarkable, and their description is omitted.

Sections from the ossified nodule from the brain were made and stained with hematoxylin and eosin. Just beneath the surface of the cortex there is an irregularly rounded nodule, three by six mm. It is surrounded by brain tissue, and from one side is a layer of brain tissue which extends partially over the nodule and separates it from the surface. The brain in the neighborhood of this nodule is fairly normal, and shows the usual nerve cells, which are normal in appearance. In the white, sub-cortical substance the brain tissue appears less dense than normal, being made up of rather loose neuroglia fibres and cells, with less than the normal number of nerve fibres. At the immediate border of the nodule there is a layer of dense neuroglia tissue, showing marked increase of the cells and fibres, especially the latter, which are also much thicker than normal. Where the nodule is not separated from the surface by brain tissue, it is covered by a rather thin layer of dense connective tissue in which there are small bundles of neuroglia fibres. This layer of connective tissue is bounded quite sharply from the brain tissue which adjoins it, by a layer of thickened neuroglia, similar to that about the ossified nodule itself. The nodule is fairly regularly oval in shape, and is composed of bone tissue in which are larger and smaller cavities, the largest being an irregularly oval one in the centre. The osseous tissue shows the usual hyaline matrix, staining a homogeneous pink, in which lie the smaller cavities, spoken of above. About these cavities the tissue shows rather an indistinct lamination, in which are lacunæ, which are more oval in form than those seen in normal bone. From some of these lacunæ canaliculi can be seen to run. Outside of this layer of bone, between it and the layer of thickened neuroglia, is a band of tissue which appears to be osteoid tissue. This area contains rather few cells, with a large amount of intracellular substance, without laminations or lacunæ. It stains homogeneously pink, but in places with a distinct bluish tinge.

The smaller spaces in the bone tissue are marrow spaces; most of them filled with a very edematous loose connective tissue. In some of them there are small blood vessels. In one of the larger the connective tissue is more dense, and there

Fig. 1. Bone tumor due to formation of true bone in the capsule around encysted coccidia oviformia. At the lower right hand side the tumor approaches the surface, and is covered by thickened pia. Elsewhere it is surrounded by thickened neuroglia. The mass of degenerated coccidia are seen in the centre. Zeiss ocular 2. Bausch & Lomb. 2 in., objective.

are quite numerous blood corpuscles lying in the connective tissue. In one or two of these spaces there are to be seen large connective tissue cells with small eccentrically placed deeply staining nuclei, and granular protoplasm resembling the connective tissue cells which have taken up fat.

At one part of this nodule there are a number of long spindle-shaped spaces surrounded by connective tissue cells and giant cells. This much resembles the granulation tissue sometimes seen around fat crystals.

The large central cavity spoken of above is filled with a granular mass, staining bluish in color, which is apparently necrotic. In this detritus lie innumerable small oval bodies, varying somewhat in size from two to three times the size of a red blood corpuscle in their long diameter. These bodies show a distinct, rather deeply staining capsule which in a few cases can be made out to be double. For the most part the capsule is empty, but many of the bodies stain bluish in color, some homogeneously, while others appear granular; others again stain a faint bluish color, with a darker oval body in the centre, suggesting a nucleus. Others again stain deeply, while the nucleus-like body is lighter in color. Occasionally three or four fine lines are seen passing from the central body to the periphery. In some cases the small body in the centre is somewhat larger, more rectangular in shape, from which the fine lines are seen passing to the periphery. This central body stains somewhat irregularly, but it is impossible to make out any definite division, or spores.

The process in this case seems to have been an acute degeneration and softening of the brain from the presence of the coccidium oviforme; followed by encapsulation; the formation of fat crystals from the breaking up of the myelin and other brain structures and leucocytes; the formation of granulation tissue about this area; followed by ossification, and secondary gliosis in its neighborhood.

Anatomical Diagnosis : acute pneumonia of middle lobe of right lung with acute fibrinous pleurisy. Ossified coccidial abscess of anterior frontal convolution with atrophy of the convolution.

Leuckart gives perhaps the best description of the coccidium oviforme, which with the gregarinæ, sarcosporidæ, myxosporidæ, and the microsporidæ form the class of sporozoa, although the classification is still a matter of dispute. It is a well known parasite of the liver of rabbits, and has

been described in the liver and intestines, and ocasionally in other organs, in many animals, although it is as yet uncertain with how many varieties of the parasite we have to do in these cases. The coccidium oviforme is a slightly irregular oval body 0.033–0.037 mm. long, and 0.015–0.020 mm. wide, with a thick smooth capsule. The contents, which are usually granular, are sometimes gathered into a mass in the centre, sometimes occupy the whole of the interior of the capsule. The capsule is double, the inner one, which is the thinner, being formed late. At one end the capsule is slightly flattened, and there is a micropyle. Reproduction takes place by spores. Usually the granular contents divide into four masses, and in these develop four oval spores, 0.012 mm. long, by 0.007 mm. wide, surrounded by a delicate envelope in the form of a C-shaped curved hyaline rod. This seems to be as far as the process goes in the body of the host, according to Leuckart, who states that the ripening of these spores takes place outside of the body, probably in water, and occupies from four to six weeks. Other observers have described another method of spore formation in which the whole granular mass within the capsule develops into an immense number of spores, and claim that this method of reproduction takes place within the host.

In the liver the coccidium is found within the liver cells, and lying free in the cavities which have formed, and does not tend to produce any marked inflammatory reaction, nor proliferation of liver, or connective tissue cells. M'Fadyean, writing in 1894, describes a nucleus and a nucleolus in the coccidium oviforme, disagreeing with most writers in this.

This parasite has occasionally been found in man. Delépine (page 381) says it has been found in the alimentary canal, liver, spleen, kidneys, ureter, urinary bladder, lungs, pleura, muscle of the heart, skin, and hair. The instance of finding the coccidium upon the hair, reported by a student of Leuckart, has been rejected by Leuckart himself. Künstler and Pitres report a very interesting case in which the coccidium was found in a case of purulent pleuritis. McFarland, in a recent paper, has collected a number of cases of human infection by this parasite. He quotes fourteen articles, in

which twenty cases are reported. Of these twenty cases, eleven were of the liver, five of the intestine, two of the kidney, and one each of the spleen and pleura. The cases which he quotes are as follows:

1. Gabler, of the liver. 2. Dressler, of the liver. 3, Sattler, of the liver. 4. Peris. Two cases, intestine (?). 5. Virchow, of the liver. These cases are all quoted from Leuckart. 6. Podwyssozki, four cases, all of the liver. 7. Silcock (reference wrong). 8. Eimer. Two cases of infection of the intestines. 9. Railliet and Lucet. Two cases of intestines. 10. Kjellberg, of the intestines. 11. Lindemann, of the kidney. 12. Railliet and Lucet, of the kidney. 13. Künstler and Pitres, of the pleura. 14. Keen, of the liver.

This last case, reported by Keen, seems at least doubtful, as to whether it was caused by the coccidium, and probably should be rejected from this list.

In a search of the literature, as complete as was practical, outside the case of Bidder, which was reported as a case of osteoma of the brain, no case of invasion of the brain of man by the coccidium oviforme has been found. Szczypiorski, in his treatise upon parasites of the brain, published in 1890, after rejecting a few very doubtful cases, and speaking with some doubt of the only case in which the scolex of the bothriocephalus latus was found, says that the scolex of the tenia mediocanellata has been observed only once, and that of the other cases he has been able to find 336 were of cysticercus cellulosæ, and 73 echinococcus.

The other point in this case, which is of interest, is the formation of true bone in the brain. While calcification, and even ossification of portions of the meninges is not extremely rare, the formation of bone in the brain itself certainly is so, though calcification of various new growths, and of cysticercus, and echinococcus cysts is comparatively common.

Of the cases of bony growths in the brain, which were accessible, the earliest which we have found mentioned is that of Leutin, in 1785, which was in the left anterior lobe, near the falx. The next case was that of Greding in 1791, in one of the lobes of the cerebellum. Wardrop, in 1827, de-

scribes an "osseous tumor" the size of a hazel nut, embedded in the substance of the middle lobe of the left cerebral hemisphere. Albers, about 1847, reported a case where he found in the left hemisphere of the cerebellum

Fig. 2. Marrow space, lacunæ and canaliculi of the bone. Zeiss ocular 4. Zeiss one-twelfth oil immersion, objective.

a bony tumor, the size of a hazel nut, and a second one lying deeper in the brain substance. Bristowe, in 1855, reports a case where there were no symptoms during life, and at the autopsy a mass was found the size of a horse bean, which occupied the position of the infundibulum and corpora albicantia. It had the shape of the infundibulum, the apex was smooth and round, and rested upon the pituitary body; the base assisted in forming the floor of the third ventricle,

and extended backwards so as to involve the corpora albicantia, of which there was no sign. It was covered by an adherent membrane. The mass was true bone, with lacunæ, canaliculi, and here and there an Haversian canal. The tumor was wholly unconnected with the dura. Petit's case was published in 1858. In this there was found in the middle of the white substance of the "left anterior hemisphere" a rough, irregularly spherical tumor, 3.3 by 2.2 cm., composed of (1) a fibrous envelope, like periosteum; (2) a layer of very hard bone; (3) a cretaceous substance; (4) a layer of fibrous tissue. Petit concluded that the tumor arose from ossification in an encysted tubercle. Benjamin, in 1858, described a large bony tumor, 7.3 by 3.0 by 2.0 cm., in the corpus callosum, more on the right side, where it rested upon the optic thalamus. This tumor showed a connective tissue capsule, firmly connected with a layer of fat; below this was the hard mass, apparently imbedded in the fat layer, which resembled a lipoma, and from which a pedicle extended into the ventricle, and there was united to the choroid. Beneath the layer of fat was a periosteal-like membrane, and the bony mass, the size of a walnut, which was found to have all the characteristics of true bone. The author thought he had to do with an ossified lipoma which had developed in the ependyma of the corpus callosum. Virchow, in his Krankhafte Geschwülste, in 1865, mentions three cases of bony tumor in the brain. One was in the left cerebral hemisphere, round, irregular, the size of a cherry stone, surrounded by connective tissue. The second was situated in the left optic thalamus, and the third in the cerebellum. Meschede, in 1866, reported a case in which there was found in the anterior and lower part of the left frontal lobe a small bony tumor, about one and one-half inches long in its longest diameter. This tumor showed the structure of true bone, and was surrounded by connective tissue, and outside of this a gelatinous substance which the author calls myxomatous, or mucoid tissue; outside of this there was some softening of brain tissue, and increase of the neuroglia elements. Meschede thought the myxomatous tissue developed from the neuroglia tissue, and then secondarily the connective tissue

arose, and that this was later transformed into bone. The tumor lay in the brain substance, although covered at one point by the pia, but the author, while he admits that the growth might have had had its origin from the pia, does not think this was likely, as the connection was slight. Ebstein, in 1870, reported a case where a large bony tumor was found in the interior of the left hemisphere of the cerebellum. The tumor was 4.5 by 2.9 by 3.2 cm. in size, showed the structure of true bone, and was surrounded by dense connective tissue. There was sclerosis and atrophy of the convolutions of this side of the cerebellum. Lydall, in 1872, reported a case of what he calls a bony tumor in the substance of the brain, which is very insufficiently described, so that it is difficult to class. He says that over the right brow the substance of the brain was pinkish, and had "thoroughly softened down to the size of a hen's egg." This softened mass contained a quantity of gritty matter, which proved to be bone, the author says, though he gives no description, so that it is impossible to know upon what he bases this opinion. One piece, he says, was a little more than half an inch in length, and a quantity had become "matted together to the size of a large hazel nut." The author stated that the left kidney had an abscess on the surface, and contained hydatids. This then, was probably a case of hydatids of the brain, which was followed by calcification, or perhaps by ossification. McDowall, in 1880, reports a case which he calls a large calcareous tumor. In the interior of the temporal lobe there was a hard, bony mass, one and five-eighths inches long, by one and three-eighths inches broad, and one and six-sixteenth inches in height, which was irregularly lobulated. The author thinks this was a cystic tumor of the choroid, which had undergone calcareous degeneration, judging from the manner in which the vessels of the choroid in the descending cornu ran into the tumor. It seems probable, however, that the mass was composed of bone, because of its rough surface, and the fact that it was surrounded by connective tissue. Brigidi, in 1883, reported a case in which a portion of an echinococcus cyst was ossified, which was not interesting otherwise. Witkowski,

in the same year, reported a case of bony tumor in the left lobe of the cerebellum. It was roughly a double pyramid in shape, with a rough surface, and was surrounded by a firm fibrous membrane. It showed the structure of true bone. In the brain, in the neighborhood of the tumor, were numerous amyloid bodies. Love reported two cases of osteoma of the brain in 1884. In the first case there was a rough bony mass deep in the substance of the right occipital lobe, the size of a walnut. It had no connection with the pia or lining of the ventricle. This tumor showed the structure of true bone. The second case was of a bony deposit in the falx, and need not detain us. In 1885, Gasparini reported a case in which he found in the right frontal lobe a tumor with softening about it. In this tumor, he says the peripheral portion consisted of connective tissue, connective tissue cells and fibres, many fat granules, and some opaque and amorphous granules. The central portion consisted of true bone, with the characteristic cells and cavities. The author considered the tumor to be a glio-osteoma. Frazier, in 1894, published a case in which he found in the right frontal lobe a cavity, 2 by 1½ by 1¼ inches, the floor of which was occupied by a calcareous mass, 1 inch long, by ¾ by ¾ inch, which the microscope showed to be true bone. Dr. Oswald, in the discussion which followed, spoke of a case in which he found a mass of true bone, the size of a filbert, in the right occipital lobe.

There remains only the case of Bidder, reported in 1882. This case was that of a man of fifty-nine years who had had hemiplegia from childhood. He died from fracture of the skull. In the anterior part of the left corpus striatum, extending out into the white substance, and also into the anterior part of the optic thalamus there was a rough hard body, 4 cm. by 1. — 2 cm. by 1.5 — 3.0 cm. in size. This was surrounded by connective tissue. Microscopical examination showed the growth to be of true bone. In the centre there was a granular mass, containing great numbers of rounded bodies, which looked like degenerated or rudimentary cells. These bodies had no nuclei. There were small cavities in the bone which contained irregular, hyaline

or celloid appearing bodies, staining slightly with hematoxylon, but showing no nuclei. The author states that he is unable to make out the relation of the tumor to this granular, amorphous mass in the centre, but thinks, however,

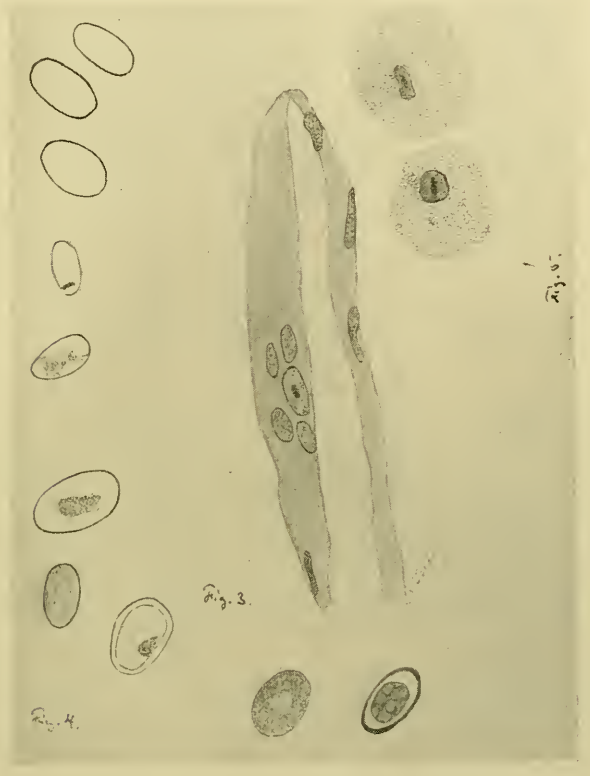


Fig. 3. Portion of spindle-shaped space, showing giant cell on the left.

Fig. 4. Coccidia.

Fig. 5. Fat granule cells.

Zeiss ocular 4. Zeiss one-twelfth oil immersion, objective.

that this was present from the first. As far as can be told from the description given of these bodies in the granular, amorphous mass in the centre of this bony tumor it seems very probable that they were, as in the case reported by the present writer, the coccidium oviforme, though the author evidently did not recognize the fact himself.

Leaving out of consideration here the cases of bone formation in the meninges of the brain, the study of these cases of bony tumor in the substance of the brain shows that the process is probably in every case a secondary one. In some cases ossification has taken place in a tumor of another kind, as in a lipoma in the case of Benjamin, or as in Gasparini's glio-osteoma. In most cases, however, it seems to have followed upon some inflammatory process of the brain, a point to which Virchow has called attention, and in these cases the formation of bone probably takes place in the connective tissue, or granulation tissue, which has formed at the site where the inflammatory process occurred. Occasionally the cause of the inflammation has been found, as when it was produced by the presence of hydatids, as in Lydall's case, or by an echinococcus cyst, as in Brigidi's case, or by the coccidium oviforme, as in this case, and probably that of Bidder.

As to the seat of bony tumors of the brain, Virchow states that it is most often in the cerebellum, a statement not borne out by the location in the cases collected in this paper. Of these cases sixteen were in the cerebrum, including one in the corpus callosum, and only five in the cerebellum, while one case, not included in either division, was in the infundibulum.

The conclusions which seems justified from the study of this case, and other cases of bony tumor of the brain are that:

1. The coccidium oviforme may occur as a parasite, in the brain of human beings.

2. That the degree of inflammation produced by the coccidium oviforme in the brain is not intense, and may run its course without noteworthy symptoms.

3. The formation of true bone in the brain seems always to be a secondary process, and occurs in other new growths, or in connective tissue, such as forms after encephalitis of slight extent and intensity.

REFERENCES.

Albers. Eläuterungen zu den Atlas der path. Anat. 1. Abthlg, Bonn. 1832–1847, 139. Quoted by Ebstein.

Bidder, A. Ein Osteom des Corpus striatum bei Hemiplegia infantilis. Virch. Arch., 1882, lxxxviii., 91.

Benjamin, L. Beschreibung einer Knockengeschwülst im Gehirn. Virch. Arch., 1858, xiv., 552.

Brigidi, V. Ossificazione della Scittizia di una Ciste d'echinococchi trovata nel cervello. Sperimentale, Firenza, 1883, li., 135.

Bristow. Tumour connected with the Brain, consisting of True Bone. Trans. Path. Soc., London, 1855, vi., 25.

Delépine, S. Gregarinosis *vel* psorospermosis, and more especially some of the effects produced by psorospermia on the liver of rabbits. Trans. Path. Soc., London, 1890, xli., 346.

Ebstein, W. Grosses Osteom der linken Kleinhirnhemisphäre. Virch. Arch., 1870, xlix., 145.

Eimer. Ueber die Ei- oder Kugelformigen Psorospermien der Wirbelthiere. Würzburg., 1870. Two cases of coccidia in intestine of man. Quoted by McFarland and by Delépine.

Fraser, D. Specimen of osseous tumour of the brain. Trans. Glasg. Path. and Clin. Soc., 1893–5, v., 141. Also, Glasg. Med. Journ., 1894, xlii., 380.

Gasparini, L. Glio-osteoma cerebrale e glioma cerebellare. Morgagni, Napoli, 1885, xxvii., 129.

Greding. Sämmtliche med. Schriften. Greiz, 1791, 321. Quoted by Ebstein.

Keen, W. W. Boston Med. and Surg. Journ., 1892, cxxvi., 405.

Künstler and Pitres. Journ. de Micrographie de J. Pelletan, Paris, 1884. Coccidia in case of purulent plueritis. Quoted by McFarland, and by Delépine.

Leutin. Blumenbach's Med. Biblioth., Bd. ii., 75, and Tab. ii., Figs. 2 and 3, 1785. Quoted by Ebstein.

Love. Two cases of osteoma of the brain. Trans. Glasg. Path. and Clin. Soc., 1884–6, ii., 47.

Lydall, W. H. A case of Bony Tumour in the substance of the Brain. Lancet, London, 1872, ii., 524.

M'Dowall, T. W. Large calcareous Tumour involving chiefly the Inner and Middle Portions of the Left Tempero-sphenoidal Lobe, and pressing upon the Left Crus and Optic Thalamus. Edinb. Med. Journ., 1880–1, xxvi., 1088.

M'Fadyean, J. Some observations regarding the coccidium oviforme. Jour. Comp. Path. and Ther. Ed. and Lond., 1894, vii., 131.

McFarland, J. The Coccidium oviforme. Journ. of applied Microscopy. Rochester, 1898, i., 41.

Meschede, F. Osteom des grossen Gehirns und Ventrikelbildung im Ammonshorn, beobachtet bei einem Epileptischen. Virch. Arch., 1866, xxxv., 472.

Oswald. Glasg. Med. Journ., 1894, xlii., 380.

Petit. Observation d'une tumeur de consistence osseuse, renfermée dans le tissu du cerveau. Jour. de la sect. de méd. de la soc. acad. du dépt. de la Loire inf., 1858, n.s., xxxiv., 308.

Podwyssozki, W. Ueber die Bedeutung der Coccidien in der Pathologie der Leber des Menschen. Centralbl. für Bacteriol. und Parasitenkunde. Jena, 1889, vi., 41.

Rivolta. Dei parasiti vegetali. Torino, 1873, 381. Coccidia in intestine. Quoted by Delépine.

Schuberg. Ueber Coccidien des Mäusedarmes. Sitzungsberichte der Phys.-med. Gesellsch. zu Würzburg, 1892, 65.

Szczypiorski, S. Des entozoaires de l'encéphale. Paris, 1890.

Virchow, R. Die krankhaften Geschwülste. Berlin, 1864, ii., 96–99.

Virchow, R. Helminthologishe Notizen. Virch. Arch., 1860, xviii., 523. On page 527 quotes case of Kjellberg where coccidia were found in the intestine of man.

Wardrop. Osseous tumour in the brain of a maniac. Lancet, London, 1827, xii., 255.

Witkowski, L. Ueber Knochen- und Concrementbildung im Gehirn. Arch. für Pshych. Berlin, 1883, xiv., 415.

V.

TWO CASES OF INFECTION WITH THE BACILLUS CAPSULATUS MUCOSUS FRIEDLÄNDER.

By Lawrence Watson Strong, M.D.

The following cases are reported to show the importance and characteristics of infections due to the Friedländer bacillus, and its relations to pneumonia.

Case I. — A man of 55 years, who was known to have chronic nephritis, was admitted to the Boston City Hospital May 23, 1898, in a comatose state. He had had several convulsions that morning, and his urine was scanty and albuminous. Physical examination of the lungs showed bronchial breathing and coarse râles. The patient died on the following day.

Autopsy sixteen hours post-mortem. Lungs: Lower lobe of left lung dark, very nodular in feeling, with irregular surface. Numerous light brown areas from one to one and one-half cm. in diameter, project above the surface; the surrounding tissue very hemorrhagic. The cut surface of these elevated, solidified areas is perfectly smooth; the secretion is mucoid, but dark red. The hemorrhagic portions are smooth and glistening, unlike the dry surface of ordinary hemorrhage. Lower lobe of right lung almost uniformly solid; dark reddish brown. On the surface is a thin layer of fibrin. Cut surface is smooth, not granular; its reddish secretion is somewhat mucoid. The upper and middle lobes show little change. The bronchi of both lungs contain a reddish, mucoid secretion. Smears from the secretion of the lungs show many capsule bacilli. The spleen is enlarged, fairly firm; its pulp not much increased. The kidneys show diminution of the cortex, granular surface and adherent capsule.

Cultures taken from the heart's blood were sterile. The liver gave a pure culture of the capsule bacillus. The spleen and kidneys showed a capsule bacillus, the colon bacillus and the pneumococcus, while both lungs gave a capsule bacillus and the pneumococcus. A guinea-pig inoculated, intraperitoneally, with one cc. of a bouillon suspension of the capsule bacillus died in eighteen hours, and pure cultures of the capsule bacillus were obtained from the heart's blood, liver, spleen and kidneys.

Microscopical examination of sections of the lungs taken from the solidified areas show the alveolar spaces greatly distended, but their contents are quite different from the exudate of ordinary pneumonias. They consist for the most part of innumerable bacilli, with capsules. With them is a moderate admixture of pus cells and desquamated epithelium. There are other areas where the bacilli are few in number and where there is a considerable exudation of leucocytes. Among them are occasionally found large phagocytic cells, containing both leucocytes and capsule bacilli. The absence of fibrin is noticeable; it occurs but scantily, and only in these areas of cellular exudation. There is considerable diffuse hemorrhage into the alveoli of sections from certain nodules, as appeared in the microscopic examination. The bronchi show marked desquamation of the epithelium, and are filled with capsule bacilli, leucocytes and blood. The pleura is practically normal except in places where there is a thin fibrinous exudate.

To sum up — the exudation present in the alveoli and bronchi in this case, consists first, of numerous capsule bacilli, which caused the peculiar mucoid secretion and smooth, glistening, transparent surface, characteristic of the pneumonias due to this organism; second, of leucocytes which vary considerably in number; third, of a very small amount of fibrin; fourth, of desquamated epithelium and phagocytic cells. In this case we have a distinctly focal solidification in the left lung, and a simulation of a lobar pneumonia in the right, which has resulted from a confluence of areas originally discrete. It those cases of pneumonia due to the Friedländer bacillus, which have been reported as lobar, it is possible that

this masking of a primary focal condition has been overlooked. The presence in this case of the pneumococcus in the cultures from the lung probably has little or no bearing on the cause of the pneumonia, because the exudate is not that which is characteristic of the diplococcus lanceolatus of pneumonia, nor does that organism appear in Gram-Weigert stains of the sections.

The capsule bacilli in tissues hardened in Zenker's fluid decolorize completely though quite slowly by the Gram method. By partial decolorization and faint counter-staining with eosin the capsules are seen as faint pink areas, within which lie beaded fragments of bacilli. The bacilli do not decolorize uniformly; sometimes the ends alone remain stained, sometimes they give beaded appearances, resembling chains of streptococci enclosed in a capsule. But a completer decolorization will make it evident whether or not any pus cocci are present. The microscopic appearances of the other organs of this case show various chronic lesions which do not bear on this discussion.

Case II. — A young man was admitted to the Boston City Hospital October 3, 1897, for a nephritis of some years standing. On October 18 a pericarditis developed, followed by a pleurisy. The course of the illness was a gradual failure with increasing edema and dyspnea, and death occurred December 9, without noticeable change in the symptoms. The temperature throughout the illness was irregular, generally somewhat elevated, but for the few days just previous to death it was sub-normal.

Autopsy six hours post-mortem. The pleural and pericardial cavities are completely obliterated by very dense fibrous adhesions. At the base of both lungs are thick deposits of pale, edematous fibrin, containing a small amount of serum. Over the lateral and upper portions of the lungs the fibrin is completely organized. The lungs are deeply injected and very edematous. No areas of solidification noted microscopically. The heart is intimately adherent to the parietal pericardium by dense fibrous adhesions. On the dependent side of the pericardium is much fibrin which is not yet organized and is pale and edematous. The kidneys

are small and granular, the cortex diminished. The right kidney contains one large abscess, and several small abscesses filled with transparent grayish pus, in which are numerous bacilli. The left kidney also contains several small abscesses. The liver presents a typical nutmeg appearance. The spleen is dark red; pulp increased, trabeculæ distinct.

Cultures made from the liver, spleen and kidney, and abscesses of the kidney gave a pure growth of the capsule bacillus. A guinea-pig inoculated intraperitoneally with 1 cc. of a bouillon suspension died in eighteen hours. The autopsy showed a slight serous exudate in the peritoneum, in which the capsule bacilli were abundant. Cultures from the heart, liver and kidney gave the capsule bacillus pure.

Sections taken from the dependent portions of the lungs show an exudate consisting chiefly of leucocytes, with a varying amount of blood, and some desquamated epithelium, but practically no fibrin. There are numerous pigmented cells of chronic passive congestion. In places clumps of capsule bacilli can be found in the alveoli, but they do not form a conspicuous part of the exudate as in other cases of pneumonia due to this organism. Within the bronchi are seen a few short chains of streptococci, and these also are found rarely among the pus cells. In one place there appears to be a broken down bronchiole surrounded by a mass of pus cells among which are capsule bacilli, cocci, and bacilli resembling the colon bacillus. Occasionally large phagocytic cells are found containing capsule bacilli and leucocytes; some of the included leucocytes also contain capsule bacilli. The epithelium of the bronchi is desquamated and there is an exudate of pus cells beneath it. The blood vessels are greatly congested, but there are no diffuse hemorrhages. In some areas the alveoli are filled with serum containing but few pus cells. The pleura is greatly thickened and cicatrized, evidently a chronic pleuritis not sharing in the acute process. The pericardium shows similar changes; no capsule bacilli appear in either tissue.

The amount of pneumonia is then very slight. It is not purely a capsule bacillus pneumonia, but it is important in that it is the probable source of the metastatic abscesses in

the kidney. The general lesions in the kidneys are those characteristic of the last stage of chronic glomerulo-nephritis. Sections taken in the neighborhood of the small abscesses seen macroscopically show in the region of the intermediary zone dilated tubules which are crowded with pus cells and some granular detritus. Among the pus cells are very many bacilli which, with their thick capsules, form a considerable part of the exudate plugging the tubules. In places the walls of the tubules have broken down, and the pus cells and bacilli have invaded the surrounding connective tissue. No bacilli can be found in the glomeruli or in the blood vessels. No other organisms appear after Gram-Weigert stain. That the infection has probably taken place through the circulation is shown by the fact that the connecting tubules at the lower end of the pyramids and near the pelvis show no inflammation. The other tissues present no lesions of special significance. There is considerable increase in the lymphoid cells of the spleen, but no leucocytes or bacilli. The liver shows marked chronic passive congestion.

The morphological and cultural characteristics of the organisms of these two cases are identical, and correspond to those of the bacillus capsulatus, mucosus Friedländer. The bacillus forms moist, colorless, gelatinous colonies on blood serum, without liquefaction. It is non-motile, grows best at 37 degrees c. but will grow at room temperature. It is facultatively anaerobic and aerobic; does not produce spores; does not coagulate milk, and gives only a slight acid reaction after five days. Peptone solution is only slightly clouded, and there is no indol reaction. In sections, and in smears of the pus from abscesses, the staining reactions are uniform. The capsule stains well by Welch's or Curry's stain, by partial Gram, by carbol fuchsin and by the alkaline methylene blue and eosin stain. The bacillus then appears as a short, thick rod, with rounded ends, surrounded by a thick, oval capsule. In artificial culture media the appearances are more variable. Sternberg and others state that the capsule does not appear in sub-cultures, but although a distinct capsule cannot be made out, surrounding the more deeply stained

bacillus, yet it is sometimes evident that there is a mucoid substance around the rod, which stains diffusely but lightly, and makes the bacillus look larger than normal.

The bacillus alone sometimes stains, and then it appears as a short, thick rod which may vary in length, however, and grow out into filaments. Again, the mucoid envelope may prevent the bacillus from staining at all, so that the organism appears like a large spore with a faint membrane.

When this organism is recovered fresh from an inoculated animal and is grown upon sugar bouillon, it produces gas in a characteristic and constant way which enables it to be distinguished from other members of the ærogenes group. But in old cultures on artificial media the gas production is quite variable and uncertain and sometimes fails altogether.

For testing the gas production, the bouillon must first be rendered free from all trace of muscle sugar by fermentation, and then 1 per cent. glucose, saccharose and lactose is added to separate portions and the fluid run into fermentation tubes. The quantity of gas produced depends on the amount of sugar present, and that in turn depends on the amount of bouillon used. The amount of gas, therefore, is stated in proportion to the amount of bouillon in the closed arm of the tube.

The Friedländer bacillus in fresh cultures grown upon 1 per cent. sugar solutions produces one-half as much gas as there is bouillon with saccharose, between one-third and one-half with glucose and less than one-fifth with lactose. Often there is only a bubble or no gas at all upon lactose.

The proportions between these three sugars are quite constant, but the total quantity of gas is more variable.

The composition of this gas may be tested for CO_2 by the addition of an alkali and for H by ignition. The proportions of the H to the CO_2 are harder to estimate depending upon the amount of CO_2 absorbed by the alkali, and the margin of error is so great that the results appear to be of less value than the relative proportions of gas already stated. Still the proportion of H to CO_2 may be stated as approximately 1.5 to 1 for saccharose and generally a somewhat higher proportion of H for glucose. In a long series of experiments these

proportions are found to be so variable that little reliance can be placed upon them.

Larger percentages of sugar give a greater total quantity of gas and take longer in the consumption of the sugar. 1 per cent. sugars are practically all consumed in forty-eight hours. There is always a little shrinkage in the column of gas after three or four days, and the gas should not be measured until that has occurred.

The pathogenic power of this bacillus is very variable. Often 3 c.c. of a bouillon culture injected into the peritoneal cavity of a young guinea-pig has failed to produce death, and the animal has recovered completely from the effects within thirty-six hours. But a virulent culture will produce a general septicemia and death in an adult pig in eighteen to twenty-four hours.

In the human system also the virulence is variable, but in both the cases reported and in several others met with in the literature of the subject there has been a general infection at the autopsy. It is noticeable also that these pneumonias have been of an asthenic type and that the infections have often been intercurrent in some chronic process.

VI.

SECONDARY INFECTION OF THE SKIN AND SUBCUTANEOUS TISSUES BY THE BACILLUS TYPHOSUS.

By Joseph H. Pratt, M.D.

Abscesses in the subcutaneous tissues and muscles during convalescence from typhoid fever were recognized by the older writers as a not uncommon complication. Murchison[1] states that he met with many such instances. Liebermeister[2] says that at Basle such abscesses were found eighty-five times among about 1,750 patients. Hölscher[3] in his analysis of 2,000 fatal cases found nine cases of suppuration of the subcutaneous tissues and seven of muscle abscesses.

The abscesses may be multiple. In the case recently reported by Templeman[4] there were thirteen; in the remarkable one cited by Bouyer,[5] twenty-three. From these he evacuated over twelve liters of pus. Curschmann[6] has seen cases in which there were sixty to eighty furuncles and abscesses that required operation.

A. Fraenkel,[7] in 1887, discovered the pyogenic properties of the bacillus typhosus. He obtained it in pure culture from an encapsulated peritoneal abscess.

Roux[8] was the first to prove experimentally the pyogenic action. He produced an abscess in a dog by subcutaneous injection of a bouillon culture of a typhoid bacillus that he had isolated from a perisplenic abscess occurring in a typhoid patient.

Orloff also produced suppuration in dogs, and many investigators, including Adenot, Orloff, Gasser, Lehmann, Buschke, Jannowski and Dmochowski, and others showed

that the typhoid bacillus was frequently able to produce subcutaneous abscesses in rabbits.

Colzi[9] performed a series of experiments with a typhoid bacillus isolated from a sub-periosteal abscess of the tibia. He injected the typhoid bacillus into the circulation, and a few days later fractured some of the bones. In eleven rabbits abscesses formed at the point of injury. In ten of these he demonstrated the presence of the bacillus typhosus.

Gasser[10] found that sterilized or filtered cultures would not produce suppuration.

If the classification of Melchior[11] is followed, the post-typhoidal suppurations of the subcutaneous tissues can be divided into three groups:

1. Secondary infections with the ordinary pyogenic bacteria.
2. Mixed infections (bacillus typhosus and the pyogenic cocci).
3. Suppurations due to the bacillus typhosus alone.

The last are rare. Vincent[12] observed one in a series of twenty-one cases of abscess and phlegmon. One hundred and twenty-nine of Colzi's[13] one hundred and thirty cases, were due to the ordinary pyogenic cocci.

Keen[14] in his recent monograph tabulates only three cases in which the typhoid bacillus alone was found in the connective tissues. And one of these cases, viz., Lockwood's,[15] we are compelled to reject, as he failed sharply to differentiate the micro-organism he obtained from the bacillus coli communis.

Dmochowski and Janowski[16] collected four cases of abscesses of the muscles in which the bacillus typhosus was the sole bacterium obtained. One of Burci's[17] cases, which they cite might perhaps be more properly classified under periostitis.

I have collected from the literature ten cases in which the typhoid bacillus alone was the cause of suppuration in the muscles and subcutaneous tissues. Abscesses probably due to periostitis have been excluded.

Chantemesse and Widal[18] isolated the typhoid bacillus in pure culture from a large abscess of the subcutaneous tissue of the abdominal wall, fifteen months after typhoid fever.

Raymond[19] studied a similar case. The abscess formed during the relapse. At autopsy a large cavity was found anterior to the abdominal muscles. It contained two liters of pus.

Schneider[20] records another. Two abscesses appeared in the abdominal wall during the fever. In this and in the recent case of Achard and Weil[21] subcutaneous inoculations were a predisposing factor. In the latter case, during the febrile period, eight days after an injection of methylene blue into the left buttock, suppuration appeared which ran a subacute course of rather long duration.

Grancher[22] reports the only case of teno-synovitis. It occurred in the fourth week.

There are six cases of abscesses in the muscles recorded by Fasching,[23] Swiezynski,[24] Tictine[25] (two cases), Daddi,[26] and Jahradnicky.[27] In Fasching's case alone were the abscesses multiple, but in only one of these was the bacillus typhosus demonstrated.

The abscesses appeared between the third and the eighth week after the onset of typhoid fever. Three were situated about the shoulder, two in the thigh, one in the gluteal region, and one in the pectoralis major.

I am able to add two cases to this series:

Case I.—Adelaide W., aged fifty-two, admitted to Dr. Sears' service September 1, 1897, in a condition of stupor. Patient had been caring for her son sick with typhoid fever; she herself had not been feeling well for four weeks. No further history could be obtained. The temperature on admission was 103°, pulse 120, soft and regular. The blood gave a positive Widal reaction, dilution 1:10. On the 2d she had two hemorrhages from the bowels. The temperature dropped from 104° to 99°. On the 9th there was another intestinal hemorrhage, with a fall of six degrees of temperature (103° to 97°) in twelve hours. On the following day the temperature rose to 101°. The nervous symptoms continued. On the 13th a swelling, purple in color, 2.5 cm. in diameter, was noticed on the inner aspect of the right lower leg. It was surrounded by an area of moderate induration, red in color. It contained a sero-sanguineous fluid, which gave a

positive reaction to the Widal serum test. She died suddenly on the 18th. There was no autopsy.

Bacteriological Examination.[1] — Culture from fluid on blood-serum shows a pure diffuse growth of a thick bacillus with rounded ends, varying somewhat in size; showing marked motility; producing no reaction in litmus-milk; no gas in sugar-agar; no indol reaction in peptone solution; positive reaction in three minutes with serum from a typhoid patient, dilution 1:10.

I have been unable to find a similar case in the literature.

It is interesting to note that the fluid possessed agglutinative properties. As is well known, tears, sweat, and other secretions and also exudations, in which the typhoid bacillus is not present, give the Widal reaction; but it is unusual for a fluid which contains the organism to have this property. Schneider[20] obtained the bacillus from a case of hydrarthrosis, but the fluid did not give the Widal reaction, nor did the pleuritic exudate in a case reported by Menetrier.[28] Courmont's[29] studies seem to show that there is an antagonism between the agglutinating substance and the typhoid bacillus, and that fluids and organs in which the bacillus is localized contain little or no agglutinating substance. On the other hand Achard[30] records a case of pleurisy in which the fluid possessed an agglutinative power ten times greater than the blood serum.

Case II.—Patrick D., aged fourteen, admitted to Dr. Lovett's service on September 27, 1898, complaining of pain, swelling and tenderness of the right elbow. Patient states he had typhoid fever a month ago. He has been up and about for the past two weeks. Present trouble is of about ten days' duration. No history of trauma.

Physical Examination. — Patient fairly well developed; somewhat emaciated. Right elbow is considerably swollen, reddened and very tender, particularly over the olecranon; surface temperature elevated; forearm held flexed to less than right angle and rotated inward; extension and supination

[1] The bacteriological examination was made by Dr. R. M. Pearce, and through his kindness I am able to report this case.

limited by pain and spasm; temperature normal on admission and remained so.

September 30. Operation (Dr. Nichols). Under ether, abscess was incised and about 6 c.cm. of thick pus escaped. No communication with the joint, or the periosteum. Patient made a rapid recovery. Discharged October 12.

Bacteriological Examination. — Cover-slip preparations show many well preserved polymorphonuclear leucocytes, numerous red blood corpuscles and large and small mononuclear cells; no bacteria.

Examination of culture reveals a medium-sized bacillus with rounded ends, possessing the following characteristics:

(1.) It does not liquefy gelatine.

(2.) It is actively motile in twenty-four-hour cultures.

(3.) It is decolorized by Gram's method.

(4.) Litmus-milk is rendered slightly acid, but not coagulated.

(5.) No gas production in 1 per cent. glucose bouillon, or in 1 per cent. saccharose bouillon or in 1 per cent. lactose bouillon.

(6.) It grows invisibly upon potato.

(7.) No production of indol in glucose-free bouillon.

(8.) It gives the Widal agglutination reaction with a typhoid serum diluted 1:60.

Conclusions.

Abscesses in the muscles and subcutaneous tissues due to the bacillus typhosus are usually single.

They appear during the latter weeks of fever or early in convalescence. Abscesses occurring as late sequelæ probably originate in a periostitis. (Chantemesse.)

The cases are acute. In this respect they contrast strongly with post-typhoid bone lesions whose course is characterized by chronicity and a marked tendency to recurrence.

They produce few constitutional symptoms.

They heal rapidly after incision.

I wish to express my thanks to Professor Councilman for permitting me to report these cases from the records of the pathological laboratory of the Boston City Hospital.

Bibliography.

1. Murchison. A Treatise on the Continued Fevers of Great Britain. 3d edit., Lond., 1884, 560.
2. Liebermeister. Ziemssen's Cyclopædia of the Practice of Medicine. Amer. ed., 1874, i., 183.
3. Hölscher. Münchener med. Woch., 1891, Nr. 3 and 4.
4. Templeman. Scot. Med. and Surg. Jour., 1898, ii., 15.
5. Bouyer. L'union méd., 1862, No. 55, 293.
6. Curschmann. Nothnagel's Specielle Pathologie und Therapie, 1898, iii., Theil 1, 115.
7. Fraenkel (A). Verh. d. vi. Congr. für innere Medicin, 1887, 179.
8. Roux. Lyon méd., 1888, No. 26, 280.
9. Colzi. Lo Sperimentale, 1890, lxv., 631.
10. Pein. Thèse de Paris, 1891, 88.
11. Melchior. Sem. méd., 1892, No. 38, 304.
12. Vincent. Merc. méd., 1892, 73.
13. Colzi. *loc. cit.*, 638.
14. Keen. Surg. Comp. of Typ. Fever, Phila., 1898, 25.
15. Lockwood. Lancet, 1895, i., 531.
16. Dmochowski and Janowski. Ziegler's Beiträge, 1895, xvii., 221.
17. Burci. Centr. f. Bakt., 1894, xvi., 131.
18. Chantemesse. Traité de Médecine, Par., 1891, T. i., 751.
19. Raymond. Le Bulletin médical, 1891, No. 15, 175.
20. Schneider. Presse méd., 1898, ii., 38.
21. Achard and Weil. Gaz. hebd. de méd. et de chir., 1898, 973.
22. Grancher. Le Bulletin médical, 1892, 1271.
23. Fasching. Wiener k. Wochens., 1892. Nr. 18, 264.
24. Swiezynski. Cent. f. Bakt., 1894, xvi., 775.
25. Tictine. Arch. Méd. Exp. et d'Anat. Pathol., 1894, vi., 1.
26. Daddi. Lo Sperimentale, 1894, 325. Quoted by Dmochowski and Janowski, Ziegler's Beiträge, 1895, xvii., 276.
27. Jahradnicky. Cent. f. Chir., 1896, 336.
28. Menetrier. Soc. méd. des Hôp., 1896, 850.
29. Courmont. Compt. rend. de la Soc. de Biol., 1897, 194.
30. Achard. Sem. méd., 1898, 417.

VII.

ACTINOMYCOSIS.

By D. H. Walker, M.D.

During recent years there have been numerous cases of actinomycosis reported, although the disease is of uncommon occurrence in this country.

The rarity of the affection in America and the fact that each of the following three cases possesses certain features of particular interest, render them of sufficient importance to be reported.

The first case is exceptional for the reason that the course of the disease was of extreme chronicity, extending over a period of eight years. The second case is of interest from the fact that the diagnosis of actinomycosis was made during life. The third case, that of actinomycosis of the tongue of a rabbit, showed the presence of a piece of vegetable material firmly imbedded in the muscular substance and surrounded by colonies of the organism.

Case 1. — A woman, aged forty-eight years, was admitted to the hospital August 5, 1897, with a diagnosis of empyema of the left chest. The previous history is unsatisfactory. In 1888 she had an attack of pleurisy for which an operation was performed on the left side of the chest below the nipple, and drainage tubes inserted and left for three months. About two years later multiple abscesses developed in the left back and were incised at that time. Old scars are also present in the anterior portion of the left chest, showing that there had been abscess formation here also.

Three weeks before entrance to the hospital the patient noticed a small lump on the left side of the chest, a little above and outside the nipple. This lump was painful to the touch. She had several chills followed by fever and sweating. She had lost considerable flesh. There was considerable expectoration which consisted of blood and a whitish substance. Upon physical examination a tender, fluctuating

swelling was observed on the left chest, the skin over which was tense and shiny, but not reddened. Several old cicatrices were present in the chest wall below the breast and also in the scapular region. Auscultation gave friction rubs and medium dry râles. There was dulness in the lower chest, above and below the breasts.

August 7th, an operation was done, and considerable foul pus, containing black flakes was evacuated. After cleaning out the cavity, a sinus large enough to admit the forefinger was found leading directly into the pleural cavity. The ribs were normal. The wound was cleansed and dressed. The patient improved until August 19th, when a red, tender, fluctuating tumor appeared on the same side of the chest, at the point of junction of the fifth and sixth ribs with the sternum. Upon the 20th, this tumor was incised and a quantity of purulent material evacuated. No bare bone was felt and there was no apparent connection with any cavity. The patient gradually became weaker and died August 23d. Cultures taken from the pus were negative. During the time she was in the hospital the temperature varied from 99° to 100°, and the pulse was about 110.

The post-mortem examination showed two centimeters to the left of the lower end of the sternum, an opening about one and one-half centimeters long, the edges of which were inflamed. Four centimeters to the left of the nipple and three or four centimeters below the nipple were similar openings. On dissecting the tissues over the left chest these openings were found to connect with sinuses which apparently led into the pleural cavity. From these sinuses could be squeezed a thin purulent fluid in which minute yellowish specks could be seen. These specks, on examination, proved to be colonies of actinomycetes. On opening the thorax the left pleural cavity was found to be obliterated. The left lung was compressed, completely solidified and intimately adherent to the chest wall and pleura. The thickness of the lung, together with the pleura was not more than seven to eight centimeters. On the pleural surface was a dense fibrous tissue about one-half centimeter thick. On cutting through the lung it was seen to be completely airless. In its centre were several large rounded cavities about two and one-half centimeters in diameter, the walls of which were reddish in color. A thin yellowish fluid could be squeezed from the cut surface. In other portions of the lung were several foci of purulent material in which actinomycetes were found. The right pleural cavity and lung as well as the remaining organs were normal. Cultures from the organs were negative.

Examination of the pus from the cavities in the lung showed in places typical colonies of actinomycetes. Some of the colonies seemed to consist almost entirely of radiating masses of club-shaped bodies, others of delicate filaments. Stained cover-slip preparations

showed many clumps of filaments dividing dichotomously, and also numerous short and long rods. As a rule the filaments did not stain evenly, but presented a finely beaded appearance.

For histological examination, many pieces of lung tissue were hardened in alcohol and imbedded partly in celoidin, partly in paraffin. The pathological process in the lung is essentially chronic in type. There is a great increase almost everywhere of the connective tissue. This is partly cellular, and more or less edematous, partly old and very dense. Everywhere it shows a great infiltration with lymphoid and plasma cells. In places are large groups of lymphoid cells, often projecting more or less into an air vesicle and suggesting lymph nodules. The bronchi and bronchioles are much compressed, irregular in outline, and contain many lymphoid cells in their walls. In places lymphoid cells and sometimes leucocytes can be seen migrating between the epithelium lining the bronchi. Many of the alveoli present are moderately distended and filled with large pale cells. Occasionally a few lymphoid cells are present. Some of the alveoli contain fibrin, much of which is hyaline in appearance. Many of these masses of fibrin are undergoing organization and are more or less surrounded or invaded by young connective tissue, blood vessels and lymphoid cells. Over large areas the alveoli are completely obliterated or represented by small cyst or gland-like cavities lined with cubical epithelium. A few corpora amylacia are present, usually within alveoli, occasionally, so far as can be made out, within lymph vessels.

Giant cells, containing many nuclei, not infrequently adjoin or partly surround the corpora amylacia. Sometimes a giant cell is also found within a lymph vessel. The larger blood vessels of the lung are more or less compressed, and frequently show marked thickening of the intima.

The walls of the abscesses are formed of quite vascular granulation tissue infiltrated with numerous lymphoid and plasma cells. The cells within the abscesses are partly polynuclear leucocytes, partly lymphoid and plasma cells. Occasionally a phagocytic cell can be found containing the more or less digested nuclear remains of the cells they have incorporated.

The colonies of actinomycetes are exceedingly few in number, and are found only in the larger cavities containing pus. Some of the colonies consist simply of compact radiating masses of delicate wavy beaded filaments, surrounded by pus cells. Other colonies present around their peripheries more or less well developed club shaped bodies of hyaline material. Besides these definite colonies small loose tangles of filaments can be found here and there among the pus cells.

Case 2. — A woman, aged 54 years, was admitted to the hospital June 18, 1896, with the diagnosis of necrosis of the superior

maxilla. Family history negative. She said she had tuberculous abscesses when a child. In March, 1896, the left cheek became red, swollen and painful. She had had trouble with her teeth, and referred the pain to them. The swelling did not diminish, and abscesses formed. The first one was over the left malar prominence.

Physical Examination. — Patient thin and pale. The mouth cannot be opened more than half an inch. The left side of the cheek from the zygoma to below the angle of the jaw is indurated, swollen and bluish in color. The left eyelid is swollen and nearly closed. There are several sinuses which discharge a thin purulent fluid. The largest is over the malar prominence, and a probe passed into it strikes bare bone. The capillaries of the cheek are injected. There is no glandular enlargement. The teeth on the left side are carious. Cultures made from the discharge showed the staphylococcus aureus and the staphylococcus albus.

June 23d the sinuses were curetted. Histological examination of the tissues obtained showed a very few colonies of delicate, wavy beaded filaments surrounded by pus cells. No club-shaped hyaline bodies could be demonstrated. Aside from pus cells a number of epithelioid cells were present, some of which contained short rods. Similar rods were present also between the cells.

June 28th a swelling which had been forming behind the left ear burst and left another sinus. On this day the patient, at her own request was discharged, unimproved, so that it was impossible to follow and study the case further.

Case 3. — The object in reporting this case is to give an example of what has been thought to be one of the common sources of infection, viz., the introduction into the body of a bit of hay, straw or grain on which the actinomycetes are supposed to live outside of the body. The lesions about to be described were found accidentally in sections of a rabbit's tongue, made for histological purposes. Only two colonies were present, both lying a short distance beneath the epidermis among the muscle fibres and entirely distinct and separate from each other. Microscopically the centre of each colony is occupied by a long piece of what appears to be vegetable material. Immediately about this is a great mass of clubs radiating from several centres. A Gram-Weigert stain brings out a few bacilli and cocci in the centres of the colonies. Lying to some extent between the masses of clubs, and also surrounding the colonies, are a few pus cells. Outside of them comes a narrow zone of epithelioid cells. Some sections show, lying close to the colonies, several large giant cells with as many as six to ten nuclei. Beyond the young connective tissue cells is a zone of dense fibrous tissue forming a capsule. In it are several large groups of lymphoid cells.

Actinomycosis in man was first observed by Langenbeck in 1845, but the case was not reported until 1878, when J. Israel published it with Langenbeck's original drawings. This case was described thoroughly, and the relations of this peculiar organism to the pathological lesions demonstrated. Hahn, in 1870, discovered actinomycetes in the tongue of a cow, and Ballinger, in 1877, showed them to be present in tumor masses about the jaws and in the tongues of cattle. Harz studied the organism and termed it "Actinomyces bovis," or "Ray fungus." The identity of this organism with that found by Langenbeck, was established by Ponfick, in 1882. Cultures of actinomyces have been obtained by many investigators. The most important characteristics of the growth on agar are that the organism is nearly anareobic and that it shows a tendency to form knots, which rarely appear before the third or fourth day, and remain separate for months. The surface growth is dry, not elevated and sends roots into the medium beneath. The older colonies are of a pale yellow color. The growth in bouillon takes the form of small yellow fluffy spherical bodies about two m.m. in diameter.

Microscopically, the most common form was found to be a short, straight or curved rod. Occasional threads were found which were wavy or spiral. In cultures on eggs, a tangle of threads is the most common form. Many of these threads can be differentiated into short rods or into coccus-like bodies, which Bostroem regarded as spores. Wolff and Israel have shown this view to be probably incorrect, for the reason that these stain readily by Gram, a property which spores do not possess. No club-shaped bodies are ever found in cultures. Wolff, Israel and Aschoff introduced portions of cultures into the peritoneal cavities of guinea pigs and rabbits, and produced tumors as large as plums, in which were found typical colonies of actinomycetes.

On section these tumors showed a connective tissue capsule, from which extended many anastomosing septa; between these were soft masses of tissue in which the colonies were situated. Smith speaks of the stage of incubation as being from fourteen to twenty-one days. Young colonies appear

gray, and consist of only a loose tangle of threads, which become, with age, denser and of an opaque white color and gradually turn to a yellow or brown. In cover-slip preparations one is inclined to suspect a mixed infection. There are seen long filaments, long and short rods and coccus-like bodies. Many of the bacilli have swollen ends of various sizes, while others have oval expansions like a spore.

The club formation is one of the important features of this bacterium. The views of Bostroem are generally accepted, that the clubs are due to a hyaline degeneration of the membrane of the rods. The filaments can often be traced into them. It is probable that the swollen ends of individual rods are beginning to undergo this degeneration.

The pathological process caused by actinomycetes is one of chronic inflammation, with the formation of firm fibrous tissue. The process in Case 1 extended over a period of eight years, which is extremely unusual; two to three years is the average time. In this case the process spoken of as pleurisy may have been due to the actinomycetes. It was impossible, of course, to tell from the history. If it were empyema due to other causes, infection with actinomycetes may have taken place through the wound, which was left open and contained drainage tubes for three months. From the location of the lesions in the lung it was impossible to tell the origin of the infection. Mallory, in a case reported by him, found many cells to contain rods and many wavy branching filaments, also giant cells containing the organism as rods and threads.

In animal actinomycosis, as has been seen in the case of the rabbit's tongue, connective tissue formation is much more abundant, and there is a great preponderance of the club form of the organism.

Infection of the human being may take place in four ways — by the mouth and pharynx; by the respiratory tract; by the gastro-intestinal tract, and by the skin. The disease is most common in wet seasons, and in people who are engaged in agricultural pursuits. Many cases have been reported of actinomycosis in persons who have been in the habit of chewing straw and grain. This seems probable, as Libmann

has been able to cultivate the organism from beans. The fungus has also been found on ears of corn. Müller states that the udders of cows become infected from contact with straw, etc. He also mentions two cases of actinomycosis of the mammary gland following blows. The fact that in each focus of actinomycosis in the rabbit's tongue, a vegetable material was the medium of infection, favors the general theory. The most common location of infection is the inferior maxilla, probably through carious teeth. It is probable that infection in Case 2 occurred in this way. Abèe reports three cases of infection through the pharyngeal wall, thence to the posterior mediastinum, causing caries of the vertebræ and a pachymeningitis cervicalis in each case. In all the cases the lungs were involved, and there were also Psoas abscesses caused by the pus burrowing underneath the kidney. In one case there was rupture into the œsophagus and thrombosis of the inferior vena cava. He considers infection to be through the blood and by contiguity. The lymph nodes are never affected. Erosions of small vessels occur, and the organisms get into the general circulation. He explains cases of actinomycosis of the brain and spleen as occurring in this way.

The diagnosis is best made by means of the microscope. The pus usually contains the characteristic yellow bodies. In lesions of the lung the yellow bodies are often demonstrable in the sputum. Smears made from the sputum or exudation can be best stained by the Gram method. In staining actinomycetes, it is important that the tissues be first firmly imbedded in celloidin so that the softened areas and the colonies will not drop out.

It is also important to show not only the filaments and the other forms of the organism, but also the hyaline swollen sheaths which surround the filaments. It is believed that Mallory's method is the best to show these forms.

No. 1. Stain sections deeply in a saturated aqueous solution of eosin for at least ten minutes.

No. 2. Wash in water.

No. 3. Stain in aniline gentian violet two to five minutes.

No. 4. Wash off with normal salt solution.
No. 5. Iodin solution (1:2:100) one minute.
No. 6. Water. Blot with filter paper.
No. 7. Aniline oil till section is clear.
No. 8. Xylol, several changes.
No. 9. Xylol balsam.

A light preliminary stain with alum-cochineal will often be found useful.

By this method the rods and filaments and coccus-like bodies are stained a dark, deep blue and the clubs stained a light pinkish color.

Eosin followed by Unna's alkaline methylene blue solution also often gives excellent results.

LITERATURE.

Abèe. Ziegler's Beiträge, vol. xxii., page 132, 1897.
Bostroem. Ziegler's Beiträge, vol. ix., pages 1–240, 1897.
Mallory, F. B. Boston City H. Med. and Surg. Reports, vol. vi., 1895.
Mallory & Wright. Pathological Technique.
Müller. Münchener Med. Wchnsch., Dec. 18, 1894.
Wolff and J. Israel. Virchow's Archiv., vol. cxxvi., p. 11–58.

VIII.

THE BLOOD IN DIPHTHERIA.

By John Lovett Morse, A.M., M.D.

The blood in this disease has received a share of the attention which has been devoted to the study of the blood during the last few years. This is not surprising, as diphtheria is a disease which can be easily and certainly recognized, and which runs a short, severe course. In fact, it is the type of an acute, infectious disease. The discovery of its antitoxin has, moreover, opened new fields for investigation, and afforded unusual, if not almost unique, opportunities for the study of the problems of leucocytosis, immunity and cure. In spite of these facts but comparatively little work has been done, however, and the results of this work are to a considerable extent contradictory and unconvincing. There is still room for more extended and careful investigation, both clinically and experimentally.

In reviewing the results which have been obtained it may be well to first consider separately the changes which occur in the red and white corpuscles in human blood, both with and without antitoxin, and then to take up the animal experiments with toxins and antitoxin, including immunization. The great interest naturally centres in the behavior of the leucocytes.

Changes in the Red Corpuscles without Antitoxin. — Bouchut and Dubroisay made repeated examinations of the blood, by Hayem's method, in eighty-four children sick with diphtheria, and obtained 4,305,000 as the mean of ninety-three counts of the red corpuscles; that is to say, a moderate diminution, which was the greater, the severer the sickness and the higher the fever. Cuffer in fifteen cases found the reds

over 5,000,000 in all but one. A second count was made but in one case. In this there was a fall of more than a million in two days. As three of his cases showed between 7,000,000 and 8,000,000 reds it is possible that all of his counts may have been 1,000,000 or 2,000,000 too high. If so, the majority of his cases showed anemia. Reinert examined the blood three times in one patient, and found a slight increase in the red elements during the fever period. Felsenthal in eight cases found no reduction in the number of red corpuscles, nor changes in their morphology or staining reaction. Gilbert in fifty-eight counts in twenty-two cases found that the reds oscillated about 4,500,000. The maximum was 5,000,000 and the minimum 4,000,000. The hemoglobin was above 90 per cent. in twelve cases. Gabritschewsky found the changes in the red corpuscles and hemoglobin unimportant in all cases. Morse in single examinations in thirty cases found the red count above 5,000,000 in twenty-one. It was below 4,000,000 in only one, a woman with chronic anemia. Stained specimens showed no marked degenerative changes. Carter found an average of 4,253,000 in thirteen cases. The maximum was 5,020,000; the minimum, 3,500,000. Billings made repeated examinations of the red corpuscles in seven cases. In five there was a distinct fall in their number and in hemoglobin. The diminution was not marked until the third or fourth day, and was proportionate to the severity of the case. Polychromatophilic cells were rather more numerous than usual, but no other changes were noted. Regeneration was slow. Filè in ten cases, some of which had had antitoxin, found the number to vary between 4,000,000 and 5,000,000. The average in eighteen counts was 4,588,000.

Changes in the Red Corpuscles with Antitoxin. — Schlesinger examined the blood daily in twenty-three cases, both before and after antitoxin. As a rule, his cases showed with the progress of the disease a slight diminution, both in the number of red cells and in hemoglobin, which was approximately parallel. Billings examined twenty-nine cases treated with antitoxin, following twenty-three throughout. Only three of the uncomplicated cases showed any diminution in

the number of red corpuscles and that less than 400,000. These were the most severe cases. There was no increase in polychromatophilia and the hemoglobin fell less than in cases not having antitoxin.

Changes in the Red Corpuscles from the use of Antitoxin in Normal Children. — Billings made repeated counts in fifteen normal children, both before and after the injection of antitoxin. The red corpuscles were diminished in seven, the diminution varying from 974,000 to 217,000. This was most marked from the second to the sixth day, and the normal was again reached in from four to thirteen days. There were no degenerative changes, and the hemoglobin was affected less than the number of corpuscles.

Summary of the Changes in the Red Corpuscles. — It is evident that the changes in the red cells are unimportant. There may be a diminution in their number. This is more likely to occur in the severe cases. It does not develop for several days. Marked degenerative changes do not occur. The hemoglobin diminishes directly with the number of corpuscles. These changes are less marked in cases treated with antitoxin. Antitoxin may in normal cases, however, apparently cause a slight diminution in the number of red cells. Regeneration is slow. The number of corpuscles returns to normal sooner than the percentage of hemoglobin.

Changes in the White Corpuscles without Antitoxin. — Bouchut and Dubroisay found in ninety-three counts in eighty-four cases an average of 26,284. The number was below 10,000 in only twelve. Bouchut found an "acute leucemic" condition of the blood in one hundred and seventy-seven observations in "septicemic diphtheria." Cuffer in fifteen cases found the leucocytes above normal in only six. These analyses cannot be accepted as correct, however, as they were made with imperfect appliances.

Rieder found a moderate leucocytosis in three cases out of five. It disappeared promptly with the beginning of convalescence. He regards the examination of the blood as of no value in the diagnosis between diphtheria and tonsillitis, and quotes Pee as saying that the leucocytosis of diphtheria is less than that of follicular tonsillitis. Felsenthal found

a leucocytosis in all of eight cases; once as high as 148,229. It disappeared with the inflammatory phenomena. Gilbert, in fifty-eight counts in twenty-two cases, found none, or a moderate leucocytosis. The maximum in the uncomplicated cases was 17,000; in those complicated with suppuration, 31,000. He concludes that there is in diphtheria a slight, inconstant leucocytosis not in accordance with the gravity of the disease, for it may be wanting in fatal cases. It has no connection with the swelling of the tonsils or of the glands. It has no diagnostic or prognostic value.

Morse made single examinations in thirty cases, and found a leucocytosis in nearly all. The maximum was 48,000. He concludes that diphtheria is accompanied by a marked leucocytosis. This is well-marked by the third day and is probably present earlier. In a general way it increases as the disease progresses, is greatest at the height of the disease, diminishes during convalescence and disappears with or soon after the membrane. With notable exceptions it corresponds in a general way with the amount of membrane. There is no evident connection with glandular enlargement. It is due to toxic absorption.

Gabritschewsky found a general leucocytosis in diphtheria from the beginning. It increased progressively in fatal cases and diminished with recovery. He considers it of bad prognostic import.

Carter examined the blood in thirteen cases. Five mild cases, making a rapid recovery, gave an average of 24,600. Four severe cases, ending in recovery, gave the highest average, 46,280. Four fatal cases all showed some leucocytosis, averaging 32,300. He concludes that slight leucocytosis occurs in mild cases with slight intoxication and in fatal cases with severe intoxication and slight resistance, and the greatest leucocytosis when there is much intoxication associated with resistance. That is, the degree of leucocytosis depends on the virulence of the infecting agent and the resistance of the animal economy. The extent of the local lesion has no effect on the degree of leucocytosis.

Ewing made many examinations in fifty-three cases. All of his cases received antitoxin, but he draws the following

conclusions with regard to the untreated disease: — Diphtheria is usually attended by a pronounced leucocytosis, reaching as high as 72,000. The increase begins a few hours after infection. In favorable cases it is greatest at the climax of the disease and steadily declines during convalescence. It may be prolonged after other local and constitutional symptoms have subsided. In unfavorable cases it continues to death. In very septic cases there may be an uninterrupted decline to death. The degree often varies with the fever, but more frequently corresponds to the extent of the local lesion. It exactly measures the systemic reaction to the toxic products circulating in the blood. High leucocytosis indicates a pronounced reaction against a severe infection. A steadily decreasing leucocytosis usually accompanies a favorable course. Slight leucocytosis usually indicates a mild infection, but fatal cases may show no increase or even a decrease of leucocytes. Simple enumeration of the leucocytes at any stage of the disease is of no prognostic value.

Filè made numerous examinations in sixteen cases. He always found a greater leucocytosis in laryngeal cases. His conclusions agree with those of previous observers and are apparently based more on their work than on his own.

Schlesinger examined twenty-four cases before antitoxin was given. Twenty-one showed more or less hyperleucocytosis, two severe and one medium case showed none. It was well developed on the first day of the disease. He concludes that age and constitution have no effect. There is no direct relation to temperature. Both are due to the same cause, but the reaction of the leucocytes is rather quicker than that of the temperature. There is no constant relation between the local lesion and leucocytosis. Severer cases, as a rule, have a greater increase, but may show a decrease. Hence the leucocyte count at the beginning of a case is of no value. The leucocyte curve, however, is of value. The leucocytosis diminishes in favorable cases and persists in unfavorable. He found that a hypoleucocytosis followed the hyperleucocytosis in three-quarters of the cases, the normal being reached again four to six days later. The minimum usually occurred on the day on which the throat was clear.

Billings studied seven cases without and twenty-nine with antitoxin. All the severe cases but one showed leucocytosis. This was the most severe. The maximum was 38,600. He concludes that the leucocytes are increased in all but two classes of cases, the very mild and the very severe. As a rule, the increase is proportionate to the severity of the case. The hyperleucocytosis often persists after the subsidence of the inflammatory phenomena. It is independent of pulse, temperature and amount of membrane. It is of no practical value in prognosis.

Changes in the White Corpuscles with Antitoxin. —Gabritschewsky studied nine cases treated with antitoxin. In the eight which recovered there was a progressive decrease in the number of white cells to normal after each injection. As the blood was examined but once a day no data were obtained as to how soon a change occurred. In the single fatal case the leucocytes increased in spite of the antitoxin.

Ewing made repeated examinations in fifty-three cases both before and after antitoxin. He concludes that antitoxin, within half an hour after its injection, causes a hypoleucocytosis. This he concludes to be the result of a negative chemotaxic action. In favorable cases the leucocytosis never again reaches its original height. In unfavorable cases the hypoleucocytosis is followed in a few hours by a hyperleucocytosis greater than before. It may be followed by rapid hyperleucocytosis or extreme hypoleucocytosis and death. He considers that the hypoleucocytosis after antitoxin is an undesirable action and should be avoided, especially in severe cases.

Schlesinger made examinations daily or oftener in twenty-four cases. He concludes that after antitoxin there is a more or less considerable and rapid diminution of the leucocytes, after which a hyperleucocytosis again occurs, which does not reach the former degree. The minimum is reached in seven hours or less, hyperleucocytosis occurring again in from twenty-four to forty-eight hours. The duration of the hypoleucocytosis varies directly with the size of the dose. In severe or fatal cases there is little or no reaction to antitoxin. When a hypoleucocytosis exists before antitoxin is given there is no

further diminution. He thinks that the action of antitoxin is obscure but that it probably neutralizes the toxin and hinders the progress of the disease processes. He considers the leucocytosis valuable in prognosis and in estimating the action of the remedy.

Filè made repeated examinations in fourteen cases. He concludes that after antitoxin a hypoleucocytosis occurs in half an hour. This is followed by a hyperleucocytosis, which reaches its maximum in five or six hours. In favorable cases this decreases in twenty-four hours. In grave cases the hyperleucocytosis continues with up and downs, never reaching normal unless more antitoxin is given. In unfavorable cases the number is inconstant but always large, is uninfluenced by antitoxin, and continues high to death.

Engel in eighty counts in thirty-two cases noted no changes as the result of antitoxin.

Billings made repeated examinations in twenty-nine cases. He made no attempt to determine the immediate effect of antitoxin on the leucocytes. He does not deny that it may have some effect. If so, it is immediate and transitory, appearing in the first hour and disappearing in twenty-four hours. He thinks that his cases show no evidence of any effect of antitoxin on leucocytosis. The leucocytosis diminished in the majority of the cases, but it always does in cases which recover. The normal was not reached any sooner than in cases without antitoxin.

Changes in the Relative Proportions and in the Morphology of the White Corpuscles. — Felsenthal found that the increase was in the polynuclear forms. Morse found that, as a rule, the increase was in the polynuclear cells; in three of his cases, however, the mononuclear cells were much increased. Billings also found that the increase, whether antitoxin was given or not, was mainly in the polynuclear forms. Ewing states that, in favorable cases, the percentage of multinuclear leucocytes is usually high and increasing, while in the fatal cases their proportion is lower and diminishing.

Besredka assumes that the whole number of leucocytes varies much in different persons, but that the proportions of mononuclear and polynuclear cells are almost constant.

Hence, in studying leucocytosis, the polynuclear cells only should be considered. He studied children between three and five years old. He fixes the maximum limit of the polynuclear cells at this age at fifty per cent. Anything above this is a polynuclear hyperleucocytosis. He examined the blood in forty-nine cases, in thirty-five of which the examinations were made daily at the same time and under the same conditions. All received antitoxin. In twenty cases the first examination preceded the antitoxin. He found that the characteristic of all curves was a considerable increase in the percentage of polynuclear cells. They increased after antitoxin. The increase lasted long after the fall of the temperature, and the appearance of other signs of convalescence. The polynuclears were very numerous when the cases tended toward recovery. Polynucleosis was absent in nine fatal cases. In fatal cases he found forms of leucocytes intermediate between mononuclear and polynuclear cells. When they appeared, death was not far distant. He concludes that children on the road to recovery show marked polynuclear hyperleucocytosis, lasting twelve to fifteen days, that children going to die in spite of antitoxin fail to show this characteristic, and that the degree of polynucleosis, after the injection of antitoxin, is one of the surest prognostic points.

Filè noted degenerative changes in the white cells. Ewing made differential counts of the white cells in blood mixed with six per cent. salt solution tinged with gentian violet. He used a peculiar classification of his own. The number and percentage of poorly staining leucocytes invariably increased with an unfavorable course of the disease. Any considerable increase always indicated a grave or fatal turn. It sometimes preceded other indications. He considers that the staining reaction of the leucocytes is an accurate measure of the severity of the diphtheritic infection, that variations in this reaction often precede changes in other symptoms, and that it is the most valuable prognostic sign obtainable from the examination of the blood. After antitoxin, the multinuclear leucocytes showed an increased affinity for gentian violet. This could be noted in twelve hours. He considers the absence

of this increased affinity after antitoxin a very unfavorable prognostic sign. Billings repeated Ewing's experiments very carefully, but was unable to verify them in any respect. He found no peculiar morphological changes. His results are probably correct.

Engel found myelocytes in many cases of diphtheria. All of those with two per cent. or more of myelocytes died; some of those with less than two per cent. recovered. A marked increase was found as early as the fourth day. In favorable cases the myelocytes diminished rapidly, and disappeared. He concludes that two per cent. or more of myelocytes justifies a fatal prognosis. No one has verified these observations.

Felsenthal in one case found leucocytes containing basophilic granules. Engel described a form of mononuclear cell, which he found only in pathological blood, which may possibly be a plasma cell.

At Dr. Councilman's request I examined the blood of nine children, sick with diphtheria, for plasma cells. Their ages varied from three to thirteen years. All were or had been severe, septic cases. Some were convalescent, others acutely sick. One died a few minutes after the blood was taken. Some had had antitoxin, others not. Ehrlich's triple stain showed nothing unusual. Cover-slips, hardened by heat and stained with polychrome methylene-blue, showed a few mononuclear cells, usually considerably larger than the ordinary small mononuclear cells, with a large, deeply staining concentric, lymphoid nucleus. The narrow rim of protoplasm was stained deeply and irregularly, but did not contain granules. Dr. Councilman considers these to be plasma cells. No relation between their number and the severity of the case, amount of membrane, temperature, or complications was apparent. The blood of a normal child, prepared in the same way, showed the same cells in approximately the same numbers. Hence they cannot be considered as of either diagnostic or prognostic importance.

Changes in the White Corpuscles from the Use of Antitoxin in Normal Children. — Filè found a slight hyperleucocytosis, reaching normal in twenty-four hours, after

immunizing injections in healthy children. Billings gave antitoxin in fifteen normal cases. In three cases the blood was counted an hour after the injection. One of these showed a hypoleucocytosis. In the others the blood was counted in twenty-four hours and then daily. The white cells showed no changes in number, relative proportions or staining reaction.

Summary of the Changes in the White Corpuscles. — The above data, although contradictory in certain respects, agree in a general way and seem to furnish sufficient basis for the following conclusions: — Diphtheria is usually accompanied by a well-marked leucocytosis. The degree varies, as a rule, directly with the severity of the disease. The increase probably begins a few hours after infection. In favorable cases it increases as the disease progresses, is greatest at the height of the disease, and steadily diminishes during convalescence. It may be prolonged after the disappearance of the inflammatory phenomena. In unfavorable cases it continues to death. In certain very severe cases, however, there may be a continuous decline to death. Very mild cases may show no leucocytosis. It has no definite relation to any other symptom. It is due to toxic absorption and measures the reaction of the system to this absorption. Hence it is absent in very mild cases in which there is little or no absorption and in very severe cases where the system fails to react. In other cases it varies with the amount of absorption and the degree of reaction. The increase is largely in the polynuclear cells.

The injection of antitoxin in diphtheria causes almost immediately a hypoleucocytosis. This is followed in some hours by a recurrence of the hyperleucocytosis. In favorable cases this soon begins to diminish and returns to normal as in untreated cases. In unfavorable cases this hyperleucocytosis persists, following the same course as in untreated cases. Nothing definite is known as to the action of immunizing injections of antitoxin upon the leucocytes.

The study of the white corpuscles is of no value in the diagnosis of diphtheria. A single examination is of no value in prognosis. Repeated examinations have a certain prog-

nostic value, both in untreated cases and in those treated by antitoxin. They show nothing, however, which is not shown equally well by the general condition of the patient.

Experiments in Animals. — In estimating the value of experiments on rabbits and horses it is well to bear in mind the investigations made by Nicolas and Courmont. They found that the normal limits of variation in the number of leucocytes in horses and rabbits were 4,000 and 12,000. In rabbits, blood taken from the two ears at the same time, from different parts of the same ear at the same time, and from inflamed and non-inflamed parts of the same ear differed materially.

Experiments with the Diphtheria Bacillus or its Toxic Products. — Carter experimented with fourteen rabbits, injecting bouillon cultures or solutions subcutaneously or into the jugular vein. He reached the following conclusions: The immediate result of all inoculations is a diminution in the number of leucocytes. Inoculations causing death may show either a subnormal number of leucocytes up to death or there may be periods in which leucocytosis is present. There is a more pronounced leucocytosis when the animal resists the disease than in fatal cases. These results are in harmony with the chemotaxic theory.

Gabritschewsky in several animals injected with bouillon cultures found a progressive hyperleucocytosis to death.

Ewing found a hypoleucocytosis in a rabbit five minutes after the subcutaneous injection of a virulent culture. The minimum was reached in five hours, the normal was regained in forty-eight hours and was followed by progressive hyperleucocytosis and death.

Chatenay used filtered cultures of toxins in four rabbits and a guinea pig. His results were all different and lead to no positive conclusions.

Morse experimented with seven rabbits, using filtered bouillon cultures of toxins. In one case he found a hypoleucocytosis in fifteen minutes. The minimum was reached in an hour and a quarter. In one hour and a quarter more the number had returned to normal, and three hours later there was a marked hyperleucocytosis. All showed a hyper-

leucocytosis. In the case which recovered it was greatest at the height of the disease, and then gradually diminished to normal. There was an increase in the number of polynuclear cells in the peripheral blood during both hypoleucocytosis and hyperleucocytosis. Sections of the lungs of animals killed during both hypoleucocytosis and hyperleucocytosis, showed an increased number of cells in the capillaries. No increase was found in the liver or kidneys. These results coincide with those obtained by Goldscheider and Jacob with other bacterial products. Morse concludes that these results corroborate the chemotaxic theory, and are explicable by it alone.

Nicolas and Courmont injected massive doses of toxins subcutaneously in six rabbits. All died in less than thirty hours. In four there was no increase in the number of leucocytes; in two the increase was marked, reaching the maximum shortly before death. They conclude that in massive intoxication the organism sometimes does not react and sometimes reacts strongly. These extremes show a profound affection of the organism which is rendered either incapable of reaction or unable to regulate its reaction, which is excessive. They also injected small doses repeatedly in seven rabbits. Hyperleucocytosis occurred in six. It reached its maximum the day after injection. The rabbit that survived showed the most marked. It was progressive to death in those that died rapidly. In the prolonged cases it showed very irregular oscillations above and below normal, very hard to explain. The case with hypoleucocytosis, however, lived a long time. On account of these variations they consider the influence of leucocytosis on the survival of the animal as somewhat doubtful. They conclude, however, that hyperleucocytosis is a symptom of intoxication and that it also measures the defense of the organism.

Besredka repeated their experiments very carefully, evidently with the object of supporting the phagocytic theory. His results in gross agreed pretty closely with theirs. He claims that their conclusions were wrong, however, as they did not study the proportions of polynuclear cells. He considers them the phagocytes par excellence and that they

play the main rôle in the protection of the organism. He, therefore, made differential counts in all cases, calculating the relative and absolute number of polynuclear cells. After massive doses he always found a progressive increase of the polynuclear cells, beginning in five or six hours and reaching its maximum in from fourteen to sixteen hours. This was followed by a rapid fall to the minimum or sub-normal just before death. He considers, therefore, that their conclusion that the organism is overwhelmed by massive doses and cannot react is wrong. He believes that his results show that the leucocytes always intervene as protectors of the organism. In slow intoxication he found that the polynuclears showed oscillations, but that they were constantly increased above the normal. He considers that this proves that the phagocytes keep up a constant struggle, ending only with the death of the animal. He concludes that the play of the leucocytes is invariably faithful to the phagocytic conception, which is alone capable of explaining the smallest details of the variations in leucocytes shown by the intoxicated organism.

Experiments with Antitoxin alone. — Gabritschewsky found that the injection of antitoxin in two normal rabbits caused a slight increase in the number of leucocytes which lasted for about twenty-four hours.

Experiments with Antitoxin in Diphtheritic Intoxication. — Gabritschewsky gave two rabbits antitoxin three hours after the injection of bouillon cultures of the diphtheria bacillus. Both showed no leucocytosis and recovered. He gave three rabbits antitoxin seven hours after injection. This did not prevent a rise which was followed in twenty-four hours by a fall. There was another rise in twelve hours which continued to death in one untreated rabbit and in one that received a second dose. The third received a second dose which was followed by a fall in twenty-four hours and recovery.

Ewing gave antitoxin after the subcutaneous injection of virulent cultures. In two rabbits he got marked hypoleucocytosis thirty and thirty-five minutes respectively after the antitoxin, followed by hyperleucocytosis and death. In a third rabbit he got a marked hypoleucocytosis in five

minutes after antitoxin. The minimum was reached in five hours. The normal was regained in forty-eight hours, and was followed by hyperleucocytosis and death.

Besredka gave large doses of antitoxin soon after massive doses of toxins. The leucocytic curve obtained was analogous to that produced by small doses of toxins. There were notable oscillations in the polynuclear cells, always, however, above the normal. The amplitude of the oscillations gradually diminished and the normal was reached in from twelve to fifteen days with the recovery of the animal.

Experiments During Immunization. — Nicolas and Courmont examined the blood of seven horses during immunization for variations both during the course of the immunization and immediately after the injections. They made frequent examinations over a long period. They found no hyperleucocytosis at any time. They conclude that the modifications of the organism which produce immunity seem able to take place without any appreciable variation in the number of leucocytes.

Besredka studied the blood of a goat during immunization. He made very many examinations over a period of five months. He found that each injection of toxin was followed by a hyperleucocytosis, the increase being entirely in the polynuclear cells. As immunization went on the polynuclears reacted less promptly, and the mononuclear cells began to replace them. The reaction was most marked in the first hours after the injections. He concludes, therefore, that the modifications of the organism which produce immunity seem to have an intimate relation to modifications of the leucocytes.

Summary of the results of experiments in Animals. — The results obtained by these various observers in experiments in animals, although they differ in numerous minor details, are in general in accordance. The injection of cultures of the diphtheria bacillus or of its toxins causes an almost immediate diminution in the number of leucocytes in the peripheral blood. In certain cases this hypoleucocytosis may persist to death. In general, however, it is soon followed by a hyperleucocytosis which in fatal cases continues to death.

In those which recover, it continues, sometimes with remissions, gradually returning to normal during convalescence. These results correspond pretty closely to those obtained in man. They are best explained by the chemotaxic theory. They all measure the reaction of the organism. Besredka's results are not inconsistent with this theory. Accepting his premises as correct, they show merely that the defensive reaction of the organism is more constant than it appears to be from the gross counts.

Too few experiments have been made with antitoxin in diphtheritic poisoning to give conclusive results as to its action. It evidently, however, causes a temporary fall in the number of leucocytes. In unfavorable cases this fall is followed by a hyperleucocytosis which continues to death. In favorable cases it is followed by a hyperleucocytosis, of less degree than before the injection, which gradually returns to normal with recovery. A possible explanation of these phenomena is that the antitoxin, temporarily at least, relieves the organism from the necessity of reaction.

Further experiments are necessary to determine what changes, if any, take place in the blood during immunization.

Conclusion. — The examination of the blood in diphtheria is of no practical, clinical importance in diagnosis, prognosis or treatment. It affords no information which cannot be obtained more easily and more quickly in other ways.

Literature Consulted.

Besredka. Annales de l'Institut Pasteur, 1898, xii., 305.
Billings. N. Y. Med. Record, 1896, xlix., 577.
Bouchut. Gaz. des Hôp., 1879, No. 20.
Bouchut & Dubroisay. Comp. Rend., 1877, lxxxv., No. 3.
Carter. Univ. M. Mag., 1894–5, vii., 17, 81, 158.
Chatenay. Thèse de Paris, 1894.
Cuffer. Revue Mens. de Méd. et de Chir., 1878, ii., 530.
Engel. Deutsche med. Wochenschr, 1897, xxiii., 118, 137.
Ewing. N. Y. Med. Journal, 1895, lxii., 161, 196.
Felsenthal. Arch. f. Kinderheilk, 1893, xv., 78.
Filè. Lo Sperimentale, 1896, l., 284.
Gabritschewsky. Ann. de l'Institut Pasteur, 1894, viii., 673.
Gilbert. Traité de Méd. Charcot-Bouchard, ii., 485.
Goldscheider & Jacob. Zeitschr, f. klin. Medicin, 1894, xxv., 373.
Morse. Boston M. and S. Journal, 1895, cxxxii., 228, 252.

Boston City Hospital Reports, 1895, vi., 373.
Nicolas & Courmont. Archives de Méd. Expérimentale, 1897, ix., 737.
Pee. Untersuchung, ü. Leucocytose. Berlin, 1890.
Reinert. Die Zählung der Blutkörperchen. Leipzig, 1891.
Rieder. Beiträge zur Kenntniss der Leucocytose. Leipzig, 1892.
Schlesinger. Archiv. f. Kinderheilk, 1895–6, xix., 378.

References not Obtained.

Gundobin. Bolnitsch. gaz. Botkina, 1897, viii., 329, 377.
Smaniotti. Gazz. d. osp. Milano, 1898, xix., 227.

IX.

A REVIEW OF THE DISEASES CONTRACTED IN THE CUBAN CAMPAIGN OF 1898. ONE HUNDRED AND TWENTY-THREE MEN.

By Henry Jackson, M.D.

From the twenty-third of August to the first of October between four and five hundred men were admitted to the Boston City Hospital, most of whom had served in Cuba; a few had been in camp at Chickamauga, or in some of the camps situated in Florida. One hundred and twenty-three of these men were entered on the first medical service.

Great interest attaches to these cases from a medical point of view, in that they offered us the first opportunity to study in a large number of cases, the various phases of malaria of the estivo-autumnal type.

Taken as a whole, these men presented many interesting phenomena. They were all dark, their skins having a peculiar yellow or brownish color, sometimes with a tinge described as muddy; many hardly looked like Anglo-Saxons, resembling rather the Armenians. The color was apparently dependent upon several factors; first, sun-burn, which of course was an important factor, but by no means the only cause of the color, as in many of the men a similar, though less marked, discoloration was seen all over the body, which had been protected by the clothing; destruction of the blood pigment evidently played quite an important part in producing the color noted, as the tint was similar to that seen in some blood diseases, as pernicious anemia, where there is destruction of blood pigment. Finally, anemia, present in a large number of the men, was important in producing the color; the anemia was evidently severe in grade, though

unfortunately the stress of work made exact counting of the corpuscles in many cases impossible; in the cases where a red count was made the number was reduced by one-half.

Almost invariably they were thin, the few exceptions only proving the rule, while many can be described only as emaciated; their eyes were sunken and lustreless, their cheeks hollow, and their bones were alarmingly prominent. In these men described as emaciated not only was there no fat tissue, but the skin had lost its elasticity and the muscles were reduced to the smallest possible size.

It was noteworthy that very few showed any evidence of skin diseases due either to neglect of proper care in washing or to vermin; in a few cases only was there edema of the legs and feet not dependent upon kidney disease.

Mentally they were marked by extreme apathy; one was not impressed that they suffered and repressed their pain, but rather that they were indifferent to pain and discomfort. Also in small ways many seemed unbalanced, almost childish in their opposition to minor hospital rules or in their wish to do things considered by the physicians as inadvisable or absolutely harmful. I dwell especially upon these changes in their mental balance because the same characteristics were noted by Dr. Prescott at Montauk and by a man, not a physician, who had charge of a station at Long Island City, where large numbers of troops were fed and cared for while *en route* from Montauk to various points in New York and the West. Dr. Prescott has said that this lack of mental balance was a source of much trouble, in that men who had been furloughed insisted upon leaving camp when they were not actually sick, and yet not well enough to travel alone. Actual delirium or wandering was seen in several cases where there was no fever sufficient to cause such a disturbance; it was dependent apparently simply upon weakness, and in each instance passed off in a few days.

There has been much discussion as to whether the sickness amongst the troops could be directly traced to carelessness or negligence on the part of the officers; after careful consideration it seems to me that in only a few instances could the diseases be traced to any source than the climatic

conditions of Cuba. Theoretically the fourteen cases of dysentery and the twenty-one cases of typhoid should have been prevented, but these diseases played but a small part in causing the sickness in comparison with the large number of cases of malaria. It cannot and should not be denied that improper and insufficient food was an important factor in causing the debilitated condition of the men.

The cases may be classified as follows:

Malaria	46 cases.
Typhoid fever	18 "
Typhoid fever and malaria	5 "
Dysentery	6 "
Dysentery and malaria	7 "
Amebic dysentery	1 case.
Debility, convalescents, etc.	37 cases.
Convalescence from yellow fever	2 "
"Collapse"	1 case.
Total	123 cases.

In all of the cases classified as malaria there was fever of a greater or less degree after they entered the hospital, those who had no fever after arriving from Cuba being classified as convalescents. Plasmodia were found in only twenty-nine cases; in eleven no blood examination was made; in eight no plasmodia were found. Several reasons may be brought forward to explain the apparent absence of plasmodia in well-marked cases; most of the men had taken quinine, some in large doses, so that it is probable that but few organisms were present; many left the hospital after a short time, going to various outlying hospitals to convalesce. In proof of the latter statement, in three cases where no plasmodia were found when the first examination was made, the organisms were abundant when the men returned after a considerable interval with a renewal of the fever. And lastly the large amount of work of a necessary character made frequent examinations impossible when the treatment of the case was not dependent upon the finding of the plasmodia. The men were so sick that in no case did I dare to

delay in giving large doses of quinine at once, so that failing to find the organisms on the first examination a second opportunity might not present itself in another rise of temperature. The organisms found were of the estivo-autumnal type in twenty-four cases, hyaline intra-corpuscular forms and crescents or ovoid bodies; occasionally pigmented forms were seen in which the granules were larger and less numerous than in the tertian plasmodia, these forms resembling rather the quartan organisms. The crescents were often present in large numbers, two, three, or more being often seen in a single field of the microscope. In three cases the tertian plasmodia were found, and these cases differed essentially from the majority in the mild character of the disease, and the readiness with which the fever yielded to quinine.

The type of the fever was varied; in one class there was a mild fever for a few days, gradually falling to normal, and without subsequent rise in temperature; in others an irregular temperature with daily rise and fall continuing for a week or so, these cases probably representing a type dependent upon the cycle of development of a single set of plasmodia. Many cases represented the typical remittent form of malaria, or at least one period of the remittent fever was developed and carried through in the hospital, suggesting that the patient had previously passed through similar periods of fever. In others, there was a continued type of fever closely resembling the course of the temperature in an average case of typhoid fever; these two latter types being of the variety which has given rise to the name "typho-malaria;" and, lastly, three cases representing the virulent type of malaria called "pernicious."

The type of the fever was independent of the treatment, as all of the cases were treated alike with large doses of quinine. Investigation of recent years makes it probable that the long-continued malarial fevers are dependent upon the presence of many sets of plasmodia, each reaching maturity at a different time and giving rise to a continuous, or almost continuous, type of fever.

Twenty-one cases with fever of short duration.

None of these men showed the emaciation so marked in those who had more severe types of malaria; some were in very good condition, but as a rule they were thin, anemic, and had the color seen in the majority of the cases previously described.

In general in all the various forms of malaria similar accounts were given of their previous condition. Fever had been present for periods varying from four to six weeks with intervals of comparative health; the periodicity of the fever differed in the various cases, but apparently bore no relation to the type presented when they entered the hospital. In some the sickness began with chills followed by fever and sweating, and the fever continued but without repetition of the chills; in others the chills recurred every day, every other day, every three days, or once a week. Many of them were quite exact in their statements as to the height of the fever, saying that their temperature had been 104° or 105° on many succeeding days. In many cases the so-called chills were not true rigors with shaking, but rather a sensation of chilliness or cold followed by periods of fever; in others true rigors were accurately described, rigors of great severity and long duration. A medical student, who acted as hospital steward in one of the hospitals, tells me that he saw true rigors in only a comparatively small number of the men who had malaria. While in the hospital very few men had rigors, certainly not more than half a dozen; in many the rise of temperature was not accompanied by sensations of cold, while in others, probably the majority, the men felt uncomfortable, rather cold and wanted to draw the blankets up over the shoulders. When rigors appeared at all they were of great severity and long continued. The absence of rigors accompanied by rapid pulse and great constitutional disturbance was in marked contrast to the usual picture in the tertian forms of malaria seen in this neighborhood.

Diarrhea was a prominent feature in most of the cases; many had from five to twenty movements daily while in Cuba, the dejections being large, watery, and occasionally mixed with blood. Vomiting was frequently described, but not often of long continuance. Headache, dizziness and blurring of the sight were present in many of the cases.

I give a few histories as types:

Case I. — Man, 23 years, 9th Mass. Vols. Well nourished, anemic. Entered the hospital September 10. About the middle of August, while in Cuba, he had pains in the hips, back and legs, with slight fever but no chills; there was headache and blurring of the vision; some diarrhea with large, watery dejections, not accompanied by abdominal pain.

Hyaline intra-corpuscular plasmodia were found. He seemed very sick upon entrance, but improved rapidly. Quinine was given subcutaneously on entrance.

Case II. — Man, 41, 9th U.S. Cavalry. Well nourished. Entered September 13. Early in August he had fever, with headache and vomiting of greenish matter; no chills. He also had cough with white expectoration. During the week previous to entrance he had felt chilly every other day. He was weak upon entrance to the hospital but improved rapidly. Plasmodia found on September 16.

Case III. — Man, 28, 2d Mass. Vols. Anemic, thin and very weak. Entered hospital August 30. Towards the end of July he had chills and fever; later he was delirious, vomited a great deal and had large watery movements. He was then up and about his regular work; for some days before entrance to the hospital he was weak and had headache and diarrhea. On September 2 many crescents were found and a few hyaline bodies. He improved rapidly.

Ten cases of fever of irregular type, with intermissions. These men were in general more seriously sick than the preceding class.

Case I. Man, 25, 9th Mass. Vols. Anemic, thin, very weak, and on entrance somewhat delirious. He entered September 6. While in Cuba he had two chills, followed by fever and sweating, and since then there had been fever, but no chills. He had ten or twelve movements daily, the dejections being large and watery, with some blood; there had been abdominal pain and tenderness, but without tenesmus and no vomiting. No plasmodia were found until September 15. The temperature was marked by sharp remissions with rapid, irregular rise in the fever, but there were no chills; quinine was given in large doses from the day of entrance. He improved gradually, and was sent to a convalescent hospital in two weeks.

Case II. Man, 20, 9th Mass. Vols. Emaciated and anemic. He entered the hospital on August 30. Six weeks previously he was taken suddenly with great weakness and general prostration, having pains all over the body; he then had chills, fever, and sweating

daily. He had diarrhea continuously, the dejections averaging ten a day, of a watery character. He went to his home September 2, and remained there for a month. During his first stay at the hospital his temperature was normal, and no plasmodia were found. While at home he was weak, and was in bed much of the time. In the last week of September he had a chill and later a sensation of chilliness, with fever and sweating every other day. When he re-entered he was pale, had a peculiar yellow color, and the sclera were also a lemon yellow. The heart was enlarged in all directions, and a soft systolic murmur was heard at the apex and over the pulmonic valves. The spleen was very hard, and extended by measurement to a point one and a half inches above the umbilicus. Hyaline intra-corpuscular plasmodia were found. For nearly two weeks he had rise of temperature every third day, but no rigors. He improved gradually, but remained in the hospital for many weeks on account of great weakness and anemia ; when discharged the spleen was much reduced in size, being just palpable ; he was fat and in good general health.

Case III. Man, 25, U.S. Regular 10th Cavalry. Fairly well nourished, anemic. Entered hospital August 21. He went to Cuba in June, took part in the battle of San Juan, July 1 and 3, and in the bombardment of Santiago, July 10 and 11. About the middle of July he had chills and fever, the chills recurring almost daily until July 25. After an interval the chills recurred, and he left Cuba August 2. The spleen was felt three inches below the margin of the ribs, and was sensitive to pressure. Hyaline plasmodia and crescents were found. He was discharged August 27, and told to consult a doctor, which he did not do.

One week after leaving the hospital he had a chill, and at irregular intervals subsequently he had fever, until he re-entered the hospital on October 6.

When he re-entered he was pale, the red corpuscles numbering 2,168,000; the spleen was hard, and was felt four inches below the ribs. Plasmodia were found. The temperature rose to 104.5° the day after entrance, but there was no chill; subsequently the temperature was normal.

Four cases of fever of remittent type.

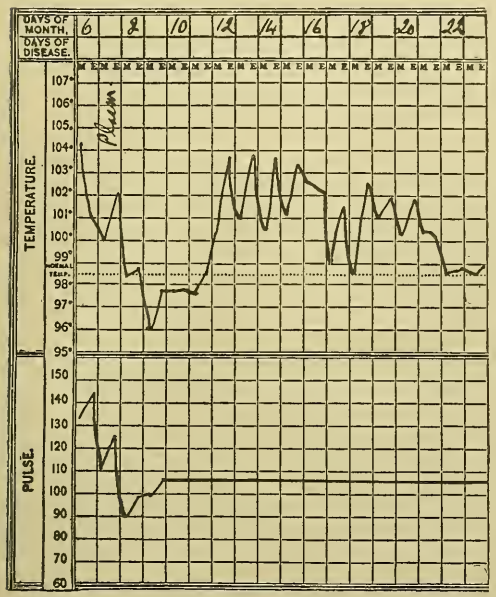
In addition to these four cases there was a fifth who had dysentery associated with the malaria, the case being reported in the class of dysentery and malaria.

These men were all very sick.

Case I. — Man, 24, 9th Mass. Vols. He entered the hospital September 6. He was very sick, emaciated, pale and sallow in

color; on entrance he was delirious, and for many days his condition was critical; for three weeks he was unable to leave the bed, and was not discharged from the hospital for two months.

Early in August he was taken suddenly with chills and fever, marked by great prostration; the fever and sweating continued at intervals up to the time of his entrance to the hospital. Diarrhea, vomiting and severe headache marked the course of his sickness.



REMITTENT TYPE

The right side of the heart was enlarged; the spleen was hard and felt one inch below the ribs. Many crescents were found in the blood. Diarrhea continued in the hospital. He had fever of an irregular type, marked by remissions without intermission for ten days; quinine did not check the fever, though under its use there was a steady improvement in his general condition. The delirium was present only during the high fever at entrance and did not recur, though he was extremely apathetic for a long time.

Case II. — Man, 23, 9th Mass. Vols. Fairly well nourished. Entered September 16. In August he had, in Cuba, chills and fever, but improved after leaving Cuba, and was fairly well until a few days before entrance, when he had headache, chilly sensations, with fever and sweating. No diarrhea, but occasional vomiting.

Hyaline plasmodia were found. The spleen was not very large. He was at no time critically sick and convalesced rapidly after the temperature reached normal.

Case III. — Man, 22, 9th Mass. Vols. Thin, anemic, weak. Entered the hospital September 6. On July 15 he had severe headache, delirium, no chills or fever; later occasional chills came on accompanied by fever and sweating. In August had diarrhea; lost twenty-five pounds; crescents were found in the blood. While in the hospital he had high fever but no chills; his only complaint was of weakness. He was discharged to a convalescent hospital

September 20. He re-entered the hospital October 6; he had been in bed for two days on account of fever and sweating; on the day of entrance he had a chill. The spleen was felt half-way between the margin of the ribs and the umbilicus; in this case purpuric spots were found scattered over the legs and thighs; they were not observed in any other case; there was a severe general bronchitis; plasmodia were found; Widal negative. In a week he improved rapidly.

Six cases of fever of continued type like typhoid.

Case I. Man, 34, 7th U.S. Regulars. Emaciated, anemic. Entered the hospital September 13. From July 21 to August 12 he had fever and headache; was then all right for two weeks, when he again had fever, headache and diarrhea; no chills. Since the end of August he had had no fever, but constant diarrhea and a good deal of abdominal pain.

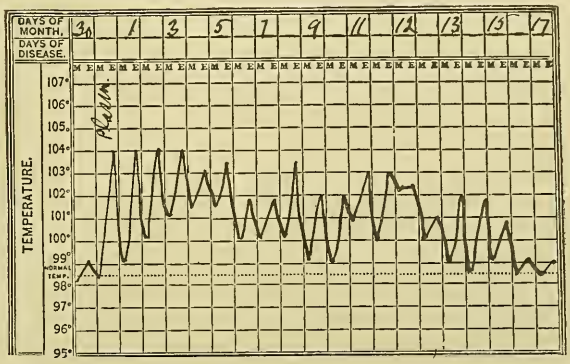
On September 15, hyaline plasmodia were found, and on the 17th crescents; Widal negative. For three weeks the fever continued, and during this time he was very weak and had diarrhea most of the time; crescents were again found on the 28th of September. He was confined to his bed for six weeks on account of weakness, but his convalescence, though slow, was steady.

Case II. Man, 21, U.S. Regulars. Was pale, weak and thin. He entered August 30. Early in August he had general pains in the bones, chills followed by fever and sweating, which recurred every three days, and profuse diarrhea. Plasmodia were found. He had fever but no chills after entrance; he improved rapidly in spite of the continued fever.

In the latter two classes the differential diagnosis from typhoid was extremely difficult; the type of fever was the same as in the cases of combined typhoid and malaria. No single sign was characteristic of either disease; several symptoms pointed more strongly towards one disease than the other. The spleen in malaria was less hard and smaller; the tongue often dry and glazed, but not coated with a thick dirty pasty coat so common in typhoid. The hebetude and stupor of typhoid were not seen in malaria; delirium in malaria was apparently associated with the high fever, and when this passed off the men were often apathetic, but did not present the mental condition usually seen in typhoid. Rose spots when seen were important.

Three cases of pernicious malaria fever.

To these might be added a fourth classified under the head of malaria and dysentery, as it was complicated by the latter disease, but the severity of the disease and the death of the patient seemed dependent rather upon the malaria than the dysentery.



REPRESENTING A CONTINUED TYPE OF MALARIAL FEVER.

The term pernicious is applied to these cases because of the severity of the acute symptoms produced by the malaria. One man entered the hospital in the height of an attack, while in the other two the symptoms came on after entrance to the hospital. They had very high fever, 105° or over, they were unconscious, cyanotic, with cold and clammy skin ; the pulse was rapid, feeble, and in fact, hardly perceptible at the wrist.

Case I. — Man, 22, 4th Artillery U.S.A. Anemic, sallow, emaciated. Entered the hospital August 23. He was unconscious upon entrance, but later the following history was obtained : About the middle of July he had chills and fever, the chills recurring every day for a week; he then had fever for a long time, but no chills; he complained of weakness, dizziness, and said he had vomited occasionally ; he was given cold baths, stimulants freely, and quinine subcutaneously, and soon recovered consciousness, though he was delirious for several days.

As shown by the chart there was a gradual but steady fall in the temperature and great improvement in his general condition.

Case II. — Man, 23, 20th U.S. Infantry. Was very pale, thin, but not emaciated, sallow in color. He was conscious upon entrance, though wandering at times. The first of August he had chills and fever, the chills recurring regularly every other day for

two weeks. While in hospital at Santiago he was delirious, had severe headache, general muscular pains, and, during the last part of August, pain, redness and swelling in the knees. There had been profuse diarrhea with a few intervals of constipation.

On the day after entrance his temperature rose suddenly to 105°, his pulse was rapid and thready, and he was absolutely unconscious; for two days the temperature was normal, when it began to rise and continued to do so daily in spite of large doses of quinine. During the second attack of fever he was not unconscious, but was delirious during a part of the time; his only complaint was of headache; no chills were seen while he was in the hospital. His convalescence was slow.

Case III. — Man, 23, 2d U.S. Regulars. Anemic, emaciated, and very weak upon entrance. He entered the hospital on September 6. About the first of August he had headache, pains all over the body and great weakness; he had fever with much sweating but no chills; mentally he was sluggish, but not delirious. A few hours after entrance he became comatose, was deeply cyanotic, the skin was cold and clammy and the pulse could hardly be felt at the wrist. For two days he remained practically in the same condition, though the coma was less marked; on the fourth day he recognized his brother, and spoke to the doctor. On September 12th he did not seem so well, areas of consolidation were found in both lungs, though his condition was so serious as to make a complete examination impossible. He died the next day, and the account of the post-mortem examination follows: Autopsy, three hours post-mortem.

Clinical Diagnosis Malaria. Body well developed and nourished; length, 179 cm; pupils slightly dilated; slight rigor mortis; over the anterior aspect of the right leg, just below ankle there were two areas with loss of epithelium, and several small blebs filled with clear serous fluid.

Abdomen: Large intestine much distended; a few slight adhesions between cecum and coils of small intestine; mesenteric glands normal; diaphragm fourth rib each side.

Pleuræ: Both pleuræ contained a slight amount of yellowish watery fluid; surface of both lungs were covered with a thin yellowish white fibrinous exudate; this was more marked over the middle and lower lobes of the right lung and over the lower lobe of the left lung; over the middle lobe of the right lung it formed a firm, thick, yellowish, false membrane. Pericardium normal. Heart weight, 355 grammes. Measurements: Tricuspid valve 12.5 cm. Pulmonary valve 6.5 cm.; Mitral valve 11 cm.; aortic valve 6.5 cm.; thickness of left ventricle 1.8 cm.; of right ventricle 0.6 cm.; valves and cavities normal; fresh preparation of myocardium shows no fat.

Right lung: Upper lobe distended, cushiony, and along the edges are seen distended air vesicles; middle lobe almost completely

solidified; beneath the thick false membrane, previously described, the lung is exceedingly firm, elevated above the rest of the lung substance and on section shows two portions distinctly marked off from one another; the outer portion of the pleuræ, about 2 cm. in width, is composed of a dark red, glistening, slightly granular, firm tissue; while the inner portion, which makes up the rest of the consolidated area, is grayish white in color, very granular, firm, and has a slightly foul odor; fresh section of this preparation shows the dark red area to have an exudate composed of considerable fibrin and few cells, while the gray area is almost entirely cellular; the lower portion of the upper lobe and the posterior portion of the lower lobe, dark red in color; rather firm; exceedingly edematous, slightly granular, but glistening, very much injected, and a portion removed sinks in water.

Left lung: Beneath the pleura of the upper lobe are many very fine hemorrhages; here and there scattered through this lobe are a few firm, dark red areas about ½ cm. in diameter, raised above the surface of the lung. In the lower portion of this lobe is an area of solidification, 6 by 3½ cm., exceedingly firm; on section grayish red in color, and in the centre is a small cavity, ½ cm. in diameter, filled with soft yellowish puriform fluid, smears from which show many pus cells, epithelial cells and a variety of organisms, among which are distinguished a long, thin bacillus, a spore-bearing bacillus, elongated diplococci and flattened diplococci occurring in short chains; lower lobe shows a lax consolidation of same nature as that in the lower lobe of right lung; it involves two-thirds of the lung, and is sharply marked off from the normal lung tissue at the base; mucous membrane of bronchi injected; cut ends of bronchi show considerable muco-pus; bronchial glands enlarged, pigmented.

Spleen, weight, 245 grammes. Capsule smooth; surface of a dark slate color; on section the surface is dark brown in color, glistening, and relieved here and there by very few minute whitish points — the Malpighian bodies; on scraping no pulp is removed; frozen section shows a large amount of black pigment.

Stomach: Mucous membrane normal, except in the cardiac end, where there is a small irregular whitish area, about 1 by ½ cm., with firm, indurated base; the mucous membrane over this area is smooth (suggestive of healed ulcer).

Liver, weight, 1960 grammes. Capsule smooth, dark brown in color, firm; on section markings indistinct; here and there are seen minute reddish specks, between which the substance is of a slate color; fresh section shows central fat, dark pigment, particularly in Kupfer's cells.

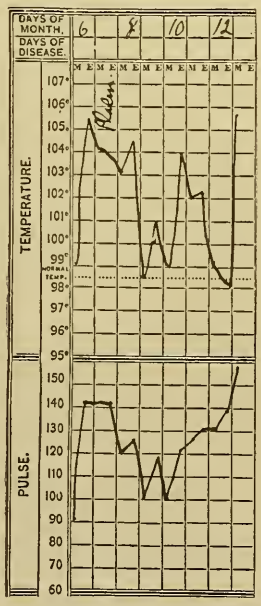
Gall bladder distended, contains about 40 c.c. of very dark yellowish fluid with exceedingly mucoid material and granular sediment.

Kidneys, weight, 355 grammes. Capsule peels easily; on section cortex, pale; relations between cortex and pyramids normal; fresh section shows no fat. Aorta, normal. Bladder, prostate and testicles normal. Bone marrow, dark red in color, firm. Head not opened.

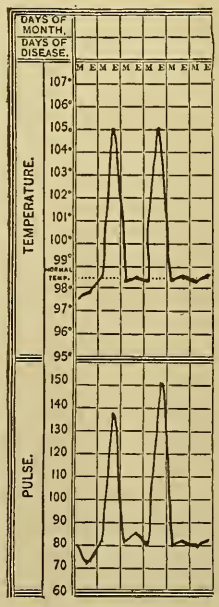
Smears from pleuræ and lungs show a variety of organisms, among which is the lanceolate diplococcus.

Anatomical Diagnosis: Acute lobar pneumonia; acute broncho pneumonia; abscess of lung; acute fibrinous pleurisy; pigment in liver and spleen; healed gastric ulcer.

In all these cases plasmodia were found, and the Widal reaction was negative. Quinine was given in large doses both by mouth and subcutaneously; baths were used to reduce the temperature, but without any practical result; strychnine was given subcutaneously as a stimulant, also alcohol in large doses. It is noticeable that the spleen was not very large in any of these men.



PERNICIOUS MALARIA.



TERTIAN MALARIA.

Three cases of tertian infection.

In three men the tertian organisms were found; the men were not much sick, were not emaciated, though thin, and the fever ceased after the exhibition of a single large dose of quinine.

As a striking picture, in sharp contrast to the irregular charts of the preceding cases of malaria of the estivo-autumnal type, I give the chart of a case of ordinary tertian malaria, which represents the course of the fever seen in cases having their origin in this neighborhood. Note the rapid pulse associated with the rigor and rise of temperature.

Spleen: The great hardness of the spleen was noticeable in all the cases; in all cases it was enlarged, and in many enormous, reaching nearly to the umbilicus. Where the spleen was very large there was usually a good deal of tenderness; one man complained of great pain in the left side, the only explanation being found in a greatly enlarged spleen, which extended almost to the umbilicus, and practically filled the lower left axillary region. The great enlargement seemed to be associated rather with a long continuance of a moderate fever than with excessively severe types of fever. In one case, on another service, autopsy showed a spleen weighing 760 grammes.

Under the treatment by quinine and the subsequent use of iron and arsenic the spleen diminished rapidly in size.

Treatment: Alcohol was given to all cases where the pulse showed any tendency to weakness, and this was often re-enforced by strychnine or digitalis. Quinine was given in large doses, always in capsule; pills are unreliable, and solutions are hard to take when such large doses are necessary. In many instances dilute sulphuric acid was given after the capsules. Bromide of ammonium or small doses of morphine checked the disagreeable ringing in the ears. In most of the cases twenty grains of quinine were given after the temperature had fallen one degree from the acme, and later five grains were given three times a day; in a few cases larger doses were given. In other cases the method of Dock was employed, giving twenty grains after the temperature fell a degree, and then giving fifteen or twenty grains every seven days for four weeks. This treatment was employed only in the cases where the temperature was normal the second day and remained so subsequently. In certain instances quinine was given subcutaneously, the preparation used

being the bisulphate dissolved in a weak solution of tartaric acid.

℞

Quin. bisulphat. . . .	Gr. V
Ac. tartarici	Gr. V
Aq.	ʒ j.
M.	

Quinine is not the quick and satisfactory specific in estivo-autumnal malaria that it is in tertian malaria; the men usually improved after quinine was given, often markedly, but in many instances, as shown by the charts published, the fever continued in unabated force. The continuance of the fever I believe to be due to the co-existence of many sets or crops of the plasmodia, each crop giving rise to fever when it reaches maturity. A single large dose of quinine appears to kill all organisms that have reached a certain stage of development; this I think is shown in the cases where after a long interval of normal temperature a sharp rise occurs, the "Dock" method is employed and subsequent rapid convalescence follows without further attacks.

Eighteen cases of typhoid fever: Five of the men had been stationed in the southern camps; thirteen were in Cuba. Two of the men died; one was extremely sick upon entrance, was constantly delirious, had incessant vomiting, and died upon the third day. The men who came from the southern camps were not so emaciated as the men that came from Cuba, but they had a typhoid of a more severe type. As a rule the cases were not very severe, some being convalescent, in whom the diagnosis was made by the Widal reaction.

Most of them had diarrhea, headache, weakness and general pains for several weeks before they were admitted to the hospital; in two or three instances there had been one or more chills. By the history, therefore, it was impossible to form any accurate opinion as to the diagnosis, as many of the cases of malaria gave a similar history, though in the latter disease chills were usually a more important factor. In many cases analysis of the blood alone made an accurate diagnosis possible. The chief points in favor of typhoid may be stated as follows: lethargy or stupor without very high

temperature; disturbance of the mental condition was seen in the malarial cases only when the temperature was very high, as in the so-called pernicious forms. A tongue heavily coated, or with a moist pasty coat. In typhoid the spleen was not so large or so hard as in the malaria cases. Abdominal tenderness and rose spots when present. The pulse in typhoid was relatively to the temperature lower and often dicrotic. Herpes was common in the malarial cases and not found in the typhoid cases. The Widal serum reaction was absolutely positive in fourteen cases, doubtful in one case; negative in one case that died very shortly after entrance, so that only one examination was made. It was negative in two cases classified as typhoid; in these two cases the history, the mental condition, the dejections, the course of the fever, all pointed to typhoid fever, and therefore this diagnosis was made; in each case repeated examinations failed to show the presence of plasmodia.

Two charts are given, one illustrative of a mild typhoid, the other a severe case, complicated by a large intestinal hemorrhage.

In five cases there was a mixed infection, malaria and typhoid fever. These cases are reported in detail by Dr. Withington in another article in this volume, and I will only say here that the course of the typhoid fever was apparently unmodified by the malaria; the malaria making itself manifest by a sharp rise in temperature late in convalescence.

Dysentery, fourteen cases: One case amebic dysentery; seven cases of dysentery with malaria, four ending fatally; six cases of dysentery without malaria, one ending fatally.

One case of amebic dysentery: A man of about forty years, entered August 30. He was thin, having lost a great deal of flesh, as was shown by a photograph taken when he enlisted, but he was not emaciated, as were many of the men who had other forms of dysentery; he was very weak. About the middle of July he was taken suddenly with fever, general pains, severe headache and was much prostrated; for two weeks he had profuse diarrhea, but continued on duty and lived on army rations. He took quinine, which had no effect upon his trouble. He entered the field hospital August 1, for ten days; in the hospital he had continuous fever, but no chills or sweating. During this time his movements were large,

watery, greenish, with blood and mucus; he did not have much pain; when discharged he was very weak, the diarrhea continued, and he had occasional vomiting. On entrance he complained especially of great weakness, and his appearance certainly corresponded with his feelings.

The liver and spleen were not enlarged; the abdomen was flat, tympanitic, not rigid and somewhat tender. His movements were small, accompanied by pain, but without marked tenesmus; they consisted of bloody mucus, with the addition of a small amount of fecal matter. Amebæ were found in the mucus; they were large, actively motile bodies, with nucleus and vacuoles. No doubt was felt by many observers who saw these bodies as to the correctness of the diagnosis. The temperature was elevated on the day of entrance, but fell to normal the following day and remained so during his stay in the hospital; throughout his sickness his pulse was between 70 and 80.

Five grains of quinine were given by mouth three times a day; the lower bowel was irrigated with a solution of quinine, twenty grains to the quart, the irrigations being given every six hours.

In a few days he improved, but had a good deal of pain when the bowels moved for the first week; after ten days the dejections were yellow and partially formed. He had two subsequent attacks of looseness of the bowels.

His improvement was rapid, and when he left the hospital on October 18 he had almost regained his former weight and appeared well.

This is the only case of amebic dysentery that has come under my observation early in the disease, the other cases that I have seen belonging to the class of cases called clinically "chronic diarrhea;" it seems possible that the early treatment of this case by quinine injections may have destroyed the amebæ before any extensive ulcerations had taken place.

This man re-entered the hospital in March, 1899, with a recurrence of dysentery.

Seven cases of dysentery and malaria: On entrance all of these men were emaciated to the last degree. In most of them the skin seemed to be tightly stretched over their bones, and the atrophy of the muscles was as marked as the entire absence of subcutaneous fat tissue. I have never seen cases showing such marked emaciation, except occasionally in cancer, where the disease has been so

situated as not to interfere directly with life, so that the individual could live as long as the heart had strength enough to beat. The mental condition was even more alarming than the physical condition; in all there was delirium during a part of the day and in two there was constant delirium till death. But more alarming than the delirium was the persistent and marked apathy; the men barely spoke unless questions were asked; they often hardly complained of pain when they were having constant bloody dejections and took no interest in what was going on about them. No pen can describe the impression made upon me by these men; several had weighed 175 pounds or more at the opening of the campaign and lay in their beds mere skeletons, with minds as weak as their bodies. Three recovered.

Case I. — Entered August 23. He was a man of large frame, very pale, emaciated, apathetic, with occasional periods of mild delirium. For several days there was edema of the lower extremities, with a good deal of pain if the legs were extended, so that he lay in bed with the thigh flexed. The pulse was weak and thready.

About the first of August he had a chill, followed by fever, and the fever had continued since then, but without the recurrence of chills. For two weeks his movements had been small, frequent, with blood and mucus. There was tenderness all over the abdomen, most marked along the course of the colon. The spleen was enlarged to percussion and the edge was easily felt.

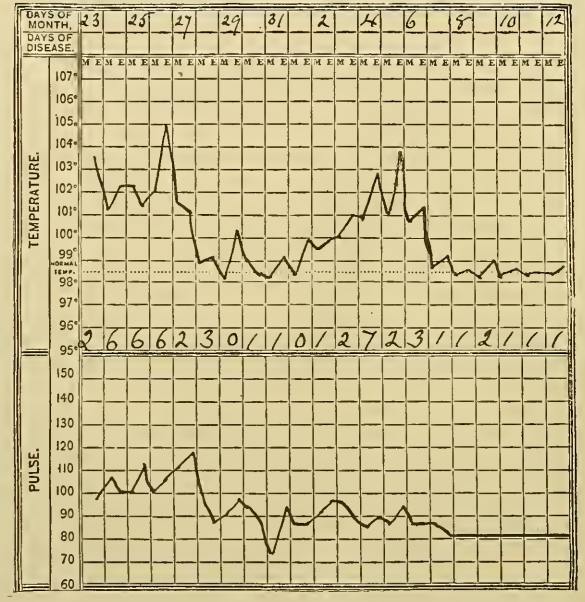
For the first few days the movements were small, loose, very frequent, bright green in color, and mixed with blood and mucus. Vomiting occurred but rarely after he entered the hospital, though he was able to take but a small amount of food; from day to day death seemed imminent, but the pulse remained at a fair rate, rising only once to 120, and in the course of three weeks he was really convalescent.

In this case, after, and perhaps because of, the exhibition of large doses of ipecac, the stools soon lost their green color, the blood disappeared and in a few days they were simply soft yellow discharges.

An air bed added greatly to his comfort. When he gradually recovered from the profound collapse present on entrance, he complained of great abdominal pain, which was controlled by morphine.

No plasmodia were found until the fifth of September, during the second rise of temperature, when organisms of the estivo-autumnal type were found. The chart is given on page 172.

On September 28, when it was first possible to weigh him, his weight was 127 pounds; October 14, he weighed 160 pounds.



MALARIA AND DYSENTERY.

Two other cases recovered; in both there was a history of chills, fever and sweating recurring daily, or every other day for a long time. Though they both had fever of a moderate degree in the hospital, plasmodia were not found in either case. One of them had a herpes zoster extending over a large area on the right flank, abdomen and thigh, which caused far more pain and distress than the dysentery. In this case a long-continued diarrhea followed the dysentery, and for weeks the man remained about as thin as upon entrance, though he gradually improved and in six weeks was discharged well.

In neither of these cases was the mental condition so serious as in the fatal cases; they were not delirious, and their condition mentally may be described rather as one of apathy and weakness.

Four cases died, three living less than a week, and one living, or rather existing, for three weeks.

In one the entry of "no history" speaks more eloquently of his condition than any words; he was so weak and so delirious that it was impossible to get any account of his previous condition.

In two of the cases there was a history of a chill some three weeks before entrance to the hospital, followed by fever and sweating, but without rigors; in each instance there was abdominal pain with great tenderness and many movements, green in color, with blood and mucus. They were delirious upon entrance and remained so throughout their sickness, developing subsultus tendinum before death. Vomiting was constant from the first, vomiting without nausea, rather regurgitation of all food taken, which absolutely prevented all attempts at giving nourishment.

In the fourth case there was a post-mortem examination and, therefore, I give the history and course of the disease in detail.

A man of thirty-six years, 9th Mass. Vols. Entered the hospital August 30. Since the early part of July he had had profuse diarrhea, the dejections varying in number from fifteen to thirty daily. At first the dejections were light in color and watery, later becoming more scanty and dark or reddish in color. There was a good deal of abdominal pain, which was relieved by the movements; the feces had a very foul odor.

He was markedly emaciated, with sunken cheeks and deep hollows under the eyes; the mental condition was one of profound weakness and apathy, with mild wandering at times.

Examination of the heart, lungs, liver and spleen showed nothing abnormal. The abdomen was lax, tympanitic, and was somewhat tender all over, especially so over the descending colon. No amebæ were found in the stools. The bowels moved frequently, the dejections being small in size, with blood, mucus and greenish matter. As in the other cases the number of dejections marked upon the chart gives no adequate idea of their frequency, as often he was for a long time upon the bed-pan before it was removed.

On September 6 many crescents were found in the blood and a few hyaline forms.

At first he was able to take only a very small amount of food; for several days he retained only somatose in broth.

On September 10 he was decidedly better, could take more food, and the blood had disappeared from the dejections; improvement continued for a week, when on September 17 he passed a considerable

amount of pure blood, and from this time failed gradually to his death on September 24. After the hemorrhage he was almost pulseless, all food was vomited, and up to the time of his death he retained only teaspoonful doses of peptonized milk.

Autopsy three-fourths of an hour post mortem. Clinical diagnosis: Dysentery. Body was still warm; no rigor mortis; body length, 169 cm., slim, extremely emaciated. Abdomen retracted so that the umbilicus rests on the lumbar vertebræ. Eyeballs deeply sunken in sockets. The right pupil dilated more than the left.

Abdominal cavity. Intestines contracted to the size of a finger, lying on each side of the vertebral column. Almost no sign of fat in omentum or mesentery. Bladder moderately dilated.

The diaphragm fifth rib left side; fourth space right side.

On opening thorax lungs contracted to a considerable degree. They were downy, of a pale pinkish-white color with very little pigmentation. No adhesions.

Heart small, weight, 185 grammes. Flabby. Valves and cavities normal. Blood in cavities fluid, but coagulated soon on exposure to air. On fresh examination no fatty degeneration present.

Left lung apparently normal. The bronchi of the right lung contained yellowish mucoid, purulent material, not very abundant. In the lower lobe were several pale grayish, but fairly translucent, solidified areas, from which on section thin pus could be squeezed.

Spleen, weight, 95 grammes. The anterior edge much lobulated. Color of a greenish black. On section the cut surface showed the same dark greenish black color. Microscopically much black pigment was present in cells.

Gastro-intestinal tract. Stomach contracted down so as to be almost tube-like in shape. Its length along lesser curvature was 15.5 cm. Along the greater curvature, 20.5 cm. Its circumference at the cardiac end was 11.5 cm. At the pyloric end, 7 cm. The wall felt thick; probably due to contraction. On opening it the stomach was empty. The mucous membrane drawn into longitudinal folds, which in places were somewhat injected. The small intestine was practically empty throughout its entire length. Wall thickened from contraction. Mucous membrane pale. Peyer's patches not visible. In large intestine, beginning at the anus and extending almost to cecum, the mucous membrane showed many ulcerations extending down to the muscular coat. The ulcerations varied in size from 2 to 3 mm. to several cm. in diameter. They were irregular in shape. The mucous membrane was much undermined, and many of the ulcerations communicated with each other beneath bridges of mucous membrane. The mucous membrane which was left was swollen, and in places rather deeply injected. In other places it was of a grayish color. A very little soft yellowish fecal material was present. On the whole, the ulcerations

were more extensive in the rectum and in the descending colon and less abundantly marked in the upper portion of the ascending colon. No mucus or blood could be found in the contents of the large intestine. Examination of the material from the surface of the mucous membrane and at the base of the ulcers beneath the mucous membrane was negative for amebæ coli.

Liver, weight, 930 grammes. Greenish black in color. On section presented the same dark color. Lobules easily made out. On fresh examination much black and reddish brown pigment present, particularly in the peripheries of the lobules.

Kidneys, combined weight, 245 grammes. Capsule peeled with difficulty. Surface slightly granular. On section cortex about normal in thickness; pale, rather translucent; markings not distinct. Reaction for amyloid negative. Microscopical examination of fresh section showed much fatty degeneration. Very small amount of light yellowish crystals in tubules.

Aorta. Intima practically normal. Only in places could a few yellowish specks be made out. Testicles normal. Bladder normal. Adrenals normal. Pancreas normal.

Anatomical diagnosis: Ulcerative colitis (amebic?); acute bronchitis and broncho-pneumonia; malarial pigmentation of spleen and liver; chronic diffuse nephritis.

Cultures: Heart and spleen, sterile. Liver and kidney, colon bacillus. Lung, micrococcus lanceolatus.

Six cases of dysentery in which there was no proof of malaria, either from the history or from the physical examination; two died, one shortly after entrance, the dysentery being complicated by pulmonary tuberculosis, and the other after a lingering illness of nine weeks. Two of the men were fairly well nourished, while four were much emaciated. Mentally they were bright, were not delirious with the exception of the case rapidly fatal and did not show the apathy so marked in the cases of dysentery associated with malaria. In three the temperature was normal and the pulse not very rapid; in one there was a temperature very suggestive of malaria, though there had been no history of chills, fever, or sweating, and no plasmodia were found.

In the case that lived for nine weeks there was throughout irregular fever with one sharp rise and during the last few days of life a temperature with extreme variations similar to the charts seen in sepsis. During seven weeks the pulse did not rise above 110 or fall below 100. The

abdomen was tender, rigid, and the stools at first consisted almost entirely of bloody mucus; there was a gradual improvement in his general condition, the dejections were yellow and infrequent, he was bright and cheerful, with a good appetite, but the loose movements returned, and he succumbed.

Treatment: In the cases with malaria, quinine was given in large doses as has been described in the report of the malarial diseases; where vomiting was present it was given subcutaneously, though without effect. Hot boric acid or alkaline injections were given in all cases and they seemed at least to afford temporary relief. Morphine was given to most of the cases, especially when pain was a prominent symptom, but without any apparent effect in checking the frequency of the dejections. Bismuth alone or in combination with salol was used in large doses, this drug being more useful in checking the dejections than morphine. The only astringent that appeared to me useful was tannigen, given in ten-grain doses. I rarely used large and continued doses of salines to wash out the bowels as all of the men were in a very weak condition, and in none of them on entrance did I dare to run the risk of the possible debilitating effect of large watery dejections. In a good many cases I gave the treatment used so extensively in India and China, ipecac and morphine; in two cases "post" and perhaps "propter" there was an almost immediate change in the character of the dejections. The green color, the blood, and the mucus disappeared, and in two or three days the stools were yellow. No vomiting was caused and there was no depressing effect even in the men who were very sick. The method employed was to give one-sixth of a grain of morphine subcutaneously, and half an hour later to give twenty grains of powdered ipecac in capsules; this treatment was repeated every six hours.

In giving rectal injections in dysentery great care must be taken not to distend the large intestine; I have seen a large intestine from a case of amebic dysentery that was ruptured in several places; the man collapsed immediately after a rectal injection and died in a few hours.

Convalescent men: Thirty-seven cases were in the hospital for a few days only, awaiting transference to their homes or to other neighboring hospitals where convalescents were received; nineteen passed but one day at the City Hospital. These men, like the others who were more seriously sick, showed marked evidences of the diseases and hardships from which they had suffered; eighteen had lost much flesh and many of them were weak on entrance; three were "emaciated;" one was in such a debilitated condition that in spite of his having no fever he was delirious for the first few days. Eleven of the men were in fairly good condition, suffering only from general weakness which prevented them from walking. They none of them had any fever during their stay in the hospital. Perhaps the most marked physical sign, apart from loss of flesh, was the great apathy noted in most of the men.

None of the men were in the hospital sufficiently long to enable us to make an exact diagnosis, but judging from their history most of them were convalescing from malaria. Undoubtedly many had relapses after leaving the hospital. The following table gives the symptoms complained of:

Chills and fever	9 cases.
Chills and fever. Diarrhea	10 "
Chills and fever. Diarrhea. Vomiting	4 "
Chills and fever. Insolation	2 "
Diarrhea	4 "
Diarrhea. (Nephritis)	1 case.
Weakness	5 cases.
Jaundice	1 case.
Syphilis	1 "
Total	37 cases.

The two cases having respectively nephritis and jaundice gave no evidence in their history of a preceding malaria.

Those who had diarrhea in Cuba described a most severe form, many of them having had eighteen to twenty movements a day. Some of the cases had true rigors, with general shaking; more of them described their chills as a sensation of cold, followed by sweating, but without shaking. The attacks of fever lasted a few days, were followed by a period of weakness, when the fever again returned.

Two cases convalescent from yellow fever.

Both were members of the 2d Mass. Vols. They entered the hospital on August 30. They were well-developed men; the one in fair general condition and the other thin, poorly nourished and anemic.

Case I. — About the first of August he was taken suddenly sick, having at this time severe headache and backache; two days later vomiting came on and on one occasion was described as being brown. The attack lasted about a week, and apparently was not severe.

For two days there was fever, but later it was normal. No plasmodia of malaria were found.

Case II. — Towards the end of July he was taken suddenly with a severe chill, and for the next two weeks remembered nothing of what occurred. He was told that during this time he was very sick and had frequent large involuntary dejections. During convalescence he was fairly comfortable, suffering only from a moderate diarrhea and weakness.

On entrance to the hospital he was weak, anemic, and his complexion had a peculiar, muddy color; the color of the skin was different in tone from that seen in the majority of the men who had been in Cuba, and who had suffered from malaria.

There was no fever. The patient had a moderate bronchitis, which cleared up rapidly. The spleen was enlarged, the edge being easily felt.

In both of these cases there was a marked discoloration of the finger nails that Dr. McCollom said was suspicious, and frequently seen in yellow fever; namely, at the root of the nail was a pinkish crescentic area marking the growth of the nail since the sickness; the older part of the nail had a deep yellow, almost saffron, color. In the two cases observed, this yellow discoloration of the nail was very different from the dirty brownish-yellow discoloration of the nails which was seen in the majority of the cases of malaria returning from Cuba.

I draw especial attention to this phenomenon, as, so far as I know, it is not mentioned in any printed article upon yellow fever; yet Dr. McCollom considers it of importance in the diagnosis. Both the men convalesced rapidly, and left the hospital in a few days.

Case of collapse. Acute gastro-enteritis:

A man of twenty-eight years, fine physique and fairly well nourished, was brought to the hospital late at night in an unconscious condition. He was a member of the 1st Maine Vols. and was *en route* from Chickamauga to Maine. On the train he was suddenly seized with vomiting and diarrhea, and when he reached Boston was so weak that he could not stand. We later found out that he had had diarrhea at Chickamauga for several weeks.

On entrance he was cold, cyanotic, at first absolutely unconscious, later partially conscious; his temperature was 97°, and the pulse rapid and scarcely perceptible; there was constant vomiting and small involuntary movements. His condition appeared so critical that he was quickly wrapped in blankets without removing his clothes; strychnine, atropia, and brandy were given subcutaneously. Nothing was given by mouth for several hours, and then he was given small doses of very hot water before any attempt was made to add nourishment. The following day he recovered consciousness and from this on made an uninterrupted recovery.

I give in detail this case, because, though it does not represent any type of a definite disease, it was to me the most remarkable instance of severe collapse due to exhaustion in a man previously perfectly healthy. I think my house officer, Dr. Stevens, made the correct diagnosis when he called the condition "Collapse of cholera infantum."

His temperature was 100° on the morning after entrance, later normal.

Examination of the heart: In view of the various disturbances of the heart seen in the soldiers of the rebellion, it is interesting to consider what conditions were found in the soldiers who returned from the Cuban campaign. It is as yet too early to form any opinion as to what the ultimate result will be, and most of the cases seen at the City Hospital were seriously ill. In the war in Cuba most of the men suffered from disease, insufficient diet and the tropical climate, whereas in the rebellion the severe physical strain involved in prolonged marches was considered as the most probable factor in causing the so-called "soldier heart." Few of the men in Cuba were subjected to physical strain from arduous or prolonged labor. As has been previously stated, most of the men were anemic and many were

profoundly so, and it seems probable that the anemia played a more prominent part than strain in such disturbances of the heart as were found. The following data are collected from the physical examination of the heart in the 123 soldiers: Not abnormal, 69; enlarged, 18; no enlargement, murmurs, 36. Total, 123.

In the cases showing enlargement of the heart the sounds were clear in eight; in one there was a pulmonic murmur, and in one a murmur at the apex. In eight cases there was a murmur at the apex and over the pulmonic valve. In one case the enlargement was limited to the left side, in six to the right side, while in eleven cases both sides of the heart showed enlargement.

In thirty-six cases murmurs were heard in which percussion showed no enlargement of the heart; in eighteen the murmur was at the apex, in thirteen over the pulmonic area and in five at the apex and pulmonic area. In these latter cases the murmurs were undoubtedly hemic in origin.

None of the men complained of palpitation, distress in the cardiac region, or shortness of breath. Rapid or irregular action of the heart was found only in those seriously ill. As a matter of fact not only was no weakness or failure of the heart observed, but perhaps the one most prominent factor in these cases was the resistance offered to severe disease by men who were emaciated to a degree and yet showed a vitality that kept them alive as long as life was possible.

The saddest and yet the most encouraging feature in these cases was the action of the heart, sad because it showed what their health and strength must have been before they were reduced by disease; encouraging because it enabled these men to live as long as life was possible, considering the diseased conditions of organs other than the heart.

X.

COINCIDENT MALARIA AND TYPHOID INFECTIONS AS SEEN AMONG OUR RETURNED SOLDIERS.

By Charles F. Withington, M.D.

The term "Typho-Malarial Fever" has been used in certain parts of the country to denote a disease which was regarded as distinct from either typhoid or malarial fever. The term is fortunately passing out of use, though it has not been wholly abandoned. Probably most of the cases to which it was applied were really typhoid; some, perhaps, were estivo-autumnal fevers.

Since the very proper discrediting of the term "typho-malarial," many persons have doubted that the two separate entities typhoid and malaria could coexist in a patient. Dr. Gilman Thompson reported[1] a case of malarial disease, confirmed by blood examinations, interpolated into the midst of a typhoid fever, and two others in which a malarial attack occurred during the convalescence from typhoid. The discussion of this paper brought out a few other similar cases, notably one from Dr. Osler, in which there was tertian intermittent for seventeen days. Under quinine the chills were stopped, but on the twenty-second day the fever returned in what proved to be the beginning of a severe and protracted typhoid. Another interesting case by Dr. DaCosta,[2] in which during a typical typhoid tertian malarial organisms were found, completes, I think, the short list of proven *coincident* infections on record.

The experience of the City Hospital with the returned soldiers the past autumn has given an opportunity for observing

[1] Transactions Assoc. Amer. Physicians, 1894.
[2] International Clinics, 1897, vol. ii., page 98.

a few such mixed infections, which seem worthy of mention because of the evidence derivable from the recently discovered Widal test for typhoid, and because the malarial exposure of these men was generally to the estivo-autumnal form of malaria, whereas, the cases of Thompson, Osler and others, were apparently generally tertian.

The cases here treated were almost all in Cuba from June till late August and fell very generally victims to malaria while there. Late in August they were brought back, most of them to Camp Wickoff at Montauk Point. In Cuba, and in some of the camps in this country, typhoid infection occurred. The following case is the only one in which we have positive evidence by the autopsy of a coincident infection with malaria and typhoid:

Case I. — J. A. F. (Med. Records, C. 135, p. 120) aged 18, of the 2d Mass. Vols., was sick and in the hospital in Cuba about July 18, with chills and fever. At that time some vomiting and diarrhea with bloody stools. Came to Montauk Point and thence went to his home in Orange, Mass., but did not feel well at either place. About September 10 had chills and fever for five days.

Entered the hospital September 24, at which time he had had no chill for eight days. Some diarrhea, but lately constipation. The enlarged spleen could be felt, and there was a limited number of rose spots. The plasmodia malariæ were found. The Widal test was negative on September 30. On the night of October 4 he was seized while in the act of defecation with some pain in the abdomen and the temperature dropped 2°. (See Chart 1, 4-hourly record.)

The next morning the abdomen was found moderately distended, muscles rigid, tympany general except in left flank, when there was dulness. He failed during the day and died at 10.45 P.M., October 5.

The autopsy, October 6, showed a marked malarial spleen, much enlarged (weight, 430 grammes), symmetrical, of dark slate color. The follicles could not be made out, spleen fairly firm, little pulp on scraping, microscopically much black pigment in the cells. There were also numerous typhoidal ulcers, one of which at a point 55 c.m. above the ileo-cecal valve had perforated the bowel, causing general fatal peritonitis.

The foregoing case is, of course, conclusive of a simultaneous double infection. I next quote a number of cases

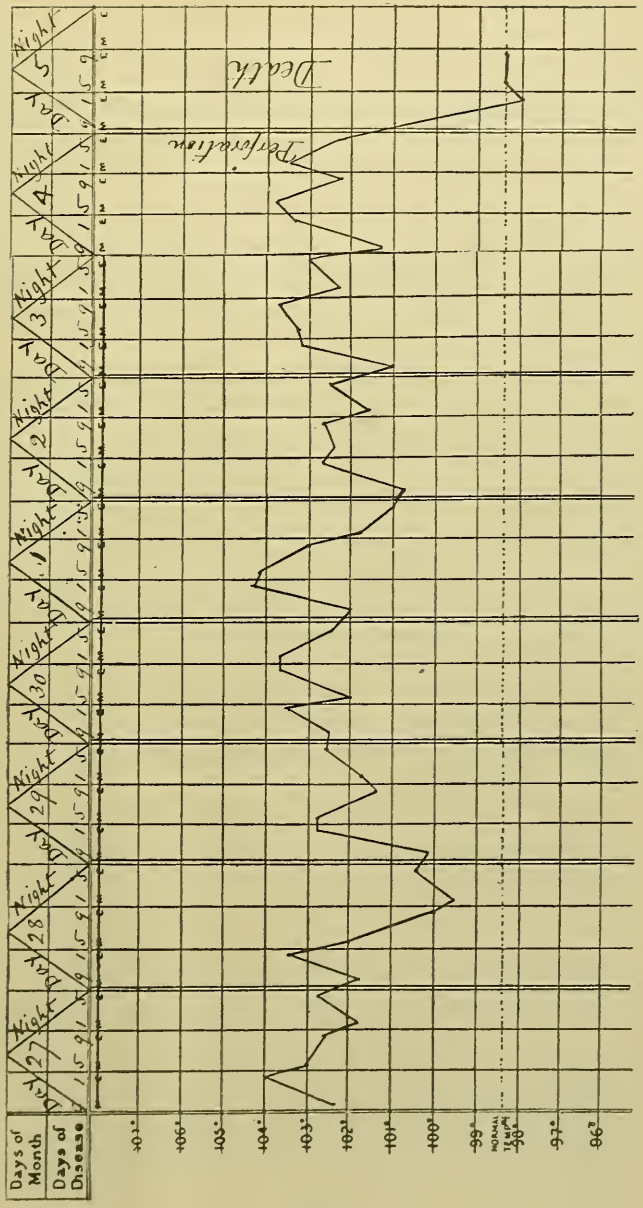

Death
Perforation
Days of Month
Days of Disease
Night
Day
NORMAL TEMP. 98°
105°
104°
103°
102°
101°
100°
99°
98°
97°
96°

CHART I

in which the probability seems very strong of a typhoid supervening upon a malaria. The evidence of primary malarial infection while in Cuba is as strong as it can be without microscopic demonstration, but the malaria was generally in abeyance during the progress of the typhoid, the latter disease running its course in some cases typically, in others more or less atypically. But in cases IV. and VIII., as well as in I., the malarial organisms were present during the typhoid, so that the two diseases coexisted. In the other cases one infection took the "right of way" over the other for the time.

Case II.—F. L. W., aged 19, 2d Mass. Vols. (Med. Records, vol. C. 133, p. 134.) Entered hospital August 30.

Had been in bed five weeks in Santiago. Chills and diarrhea. Abdomen tympanitic, not tender, except over enlarged spleen. No rose spots.

Four searches were made for plasmodia, always with negative result. On September 5 Widal reaction positive. Temperature subsided by lysis, reaching normal on September 15. No subsequent rise; no chills at any time while in the hospital.

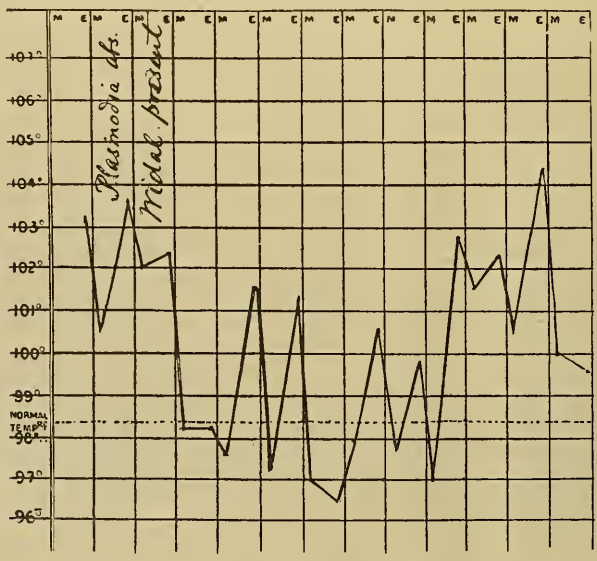


CHART 2.

Case III.—J. J. S., aged 23, 9th Mass. Vols. (Med. Records, vol. C. 135, p. 126.) Entered hospital October 2. Distinct history

of malaria around Santiago with diarrhea. Latter checked somewhat while on transport for Montauk. Then sick with fever, sweating, dysentery. Transported thence to New York Hospital, thence to Boston. Dejections fifteen daily. No chills now, but sweating. Rose spots. Repeated searches for plasmodia and for amebæ, negative. Positive Widal reaction, October 3. Delirium intense. Died October 14. No autopsy.

The chart is so irregular that it is reproduced herewith. Possibly it represents some modifying influence of the two infections upon each other. (Chart II.)

Case IV. — W. P. D., aged 31, 9th Mass. Vols. (Med. Records, C. 133, p. 218.) Entered hospital September 6. Had fever, with one or two indefinite chilly sensations in Cuba. None since. "Overcome by heat" at Montauk, and fell down. Spleen markedly enlarged. Abdomen tympanitic; one rose spot. Estivo-autumnal parasite found. Widal reaction positive, September 9 and 14. Delirious. Temperature at entrance 104.5°; reached normal in five days, and so remained.

Case V. — M. E. M., aged 35, 9th Mass. Vols. (Med. Records, c. 133, p. 218.) Entered hospital September 9. Sick four days in Cuba. One chill six weeks before leaving. While at Montauk "took cold." Diarrhea off and on. Malaise and headache. No chills since that in Cuba. Abdomen tympanitic. Rose spots very abundant. Plasmodia not found (only one search made), Widal positive. The fever ran a fairly typical typhoid course for three weeks, terminating in a very rapid lysis.

Case VI. — J. W., aged 25, 7th U. S. Infantry. (Med. Records, C. 133, p. 62.) Two weeks before leaving Cuba had chills and fever for six days. Recovered. Again, chills and fever on transport from Cuba. Felt well while at Montauk until September 5. Then malaise, headache, diarrhea. Entered hospital September 13. Rose spots. Widal reaction positive, no plasmodia. His temperature ran a fairly characteristic typhoid course, becoming normal on October 12. On the 18th a chill, while in bath. Temperature rose three degrees and returned to normal. No search for plasmodia appears to have been made on this day. For the following week there was some fever, which was supposed to be a recrudescence of the typhoid. A slow recovery with great prostration. The record shows no plasmodia at any time.

Case VII. — A. J. W., 2d Mass. Vols. (Med. Records, vol. C. 133, p. 138.) Entered August 30. Had been sick five weeks. No chills, but sweating and diarrhea. Headache for three days. Diarrhea continued. Temperature 102.6°. Spleen edge felt. After

three days temperature became normal, where it remained, except for a rise one day (September 7), until September 15. It then remained febrile, but with a gradual reduction for almost five days, after which it remained normal. Several searches for the plasmodia were made, but none were found. Severe epistaxis September 16. On September 18, a positive Widal reaction was obtained, and the same day many rose-spots were found. The whole run of the continued fever, however, occupied less than a week, and the patient made an uneventful recovery.

Case VIII. — R. F. A., 9th Mass. Vols. (Med. Records, vol. C. 133, p. 216.) Chills and fever in Cuba. Sweating. Last chill two days before entrance, September 6. Tongue brown-coated. Sordes. Spleen edge felt. Few rose-spots. Estivo-autumnal parasite found. Widal reaction positive. September 10, a "congestive chill" from which the patient nearly died. Temperature fell by rapid lysis, reaching normal seven days after admission and remaining so. Convalescence uninterrupted save for an abscess of thigh, caused by hypodermic injection of quinine.

Case IX. — B. W. K., aged 22, 9th Mass. Vols. (Med. Records, vol. 448, p. 158. Dr. Jackson's service.) From about September 1 had chills with high fever alternating with marked remissions. Entered September 14, had been in bed a week. Diarrhea, abdominal tenderness. Spleen felt. Plasmodia wanting on two searches. Widal positive. Delirium. Stupor. By September 30, temperature had fallen to normal, and so remained until October 9. Then chill and plasmodia of estivo-autumnal type. Stopped by quinine. The chart shows a pulse rate more rapid during the malarial paroxysms than it had been in equally high temperature of the typhoid.

In some of the cases a pretty definite sequence of diseases is to be noted, viz.:

(1) Malaria. (2) Typhoid. (3) Malaria.

Each of these seemed to hold the field alone for the time being, the original malaria becoming dormant while the typhoid was in progress, so that the latter disease was in all respects unmodified and then with recovery of the typhoid, the malaria reasserting itself as before.

This is well shown in the three following cases of Dr. Jackson's, which he has kindly placed at my disposal. For example:

Case X. — J. C. G., aged 23, 4th U.S. Infantry. (Med. Records, vol. 448, p. 22.) Had a sudden onset of fever, August 25. There were chills, fever and sweating of daily occurrence. Says he was

cured of this at Montauk. Entered hospital September 6. Diarrhea. Five or six dejections daily. Green to dark; slimy, twice bloody. Pain and tenderness about umbilicus. No plasmodia found. The fever reached normal for one day, September 13, for the next ten days ran about 100°, and on September 22 the Widal test was positive. From September 28, the fever was higher (102°), but had gone by October 6, and the patient was convalescent. October 20 plasmodia were present, the patient having on that day a chill which shook the bed, with temperature nearly to 105°. There were no further manifestations of the disease after this.

Case XI. — J. A. C., aged 27, 9th Mass. Vols. (Med. Records, vol. 448, p. 176.) Had had fever in Cuba, went thence to Montauk. Entered the hospital September 16. For one week had had diarrhea, headache, abdominal tenderness; also two chills. Spleen enlarged. Widal positive in ten minutes. No plasmodia. There was a chill on the night of his entrance, but none during the subsequent febrile period. The temperature fell by a rapid lysis, reaching normal September 20. The patient was discharged, well, on the 28th, the diagnosis being typhoid. He was readmitted October 4, with a temperature of 105° following a chill. On this day the estivo-autumnal parasite was found, and the Widal test gave a clumping in fifteen minutes. He was kept twenty-four days without any further symptoms, and was then discharged.

Here there was undoubted malaria in July, and again in October. From September 9 to 20 there was a continued fever with marked Widal reaction, and during this time no plasmodia were found. The record says nothing about the existence of roseola.

Case XII. — J. L. B., aged 34, 15th U.S. Artillery. (Medical Records, vol. 446, p. 110.) Entered August 23. In Cuba, in latter part of July, was sick with headache, vertigo, diarrhea, anorexia. Abdomen tender, spleen enlarged, also the liver. Widal reaction positive on three different days. No plasmodia found on entrance. After temperature had been normal for a week, a sharp rise without rigor. Plasmodia of estivo-autumnal type then found for the first time.

In diagnosticating typhoid in the foregoing cases (II. to XII.) we have been guided by the presence of rose spots in many cases, by the abdominal and other symptoms, by the temperature course, and by the Widal reaction. No one of these is infallible, but their consensus is pretty convincing. Regarding the temperature curve, as between typhoid and estivo-autumnal fever, it is not always conclusive. The

parasite of the latter disease has a very varying life-cycle, from less than twenty to more than forty-eight hours. Even if there are no intermediate crops maturing midway of the regular generations, the segmentation periods are so irregular, the paroxysms so prolonged and so prone to overlap, that all semblance of intermittency, or remittency, may be lost, and the curve be equally atypical of malaria and of typhoid.

Still, in these cases the curve is fairly suggestive of typhoid. How about the Widal reactions? Before discussing this point, I wish to report a case, which was the only one among all the soldiers treated during the season, in which a positive Widal reaction was recorded when an autopsy failed to show the presence of typhoid:

Case XIII.—S. E. L., aged 21, 2d U.S. Infantry. (Med. Records, vol. C. 133, p. 86.) Entered hospital August 23. Had been sick in Santiago hospital ever since the surrender. Constipated for a week; then profuse discharges, slimy. Vomiting

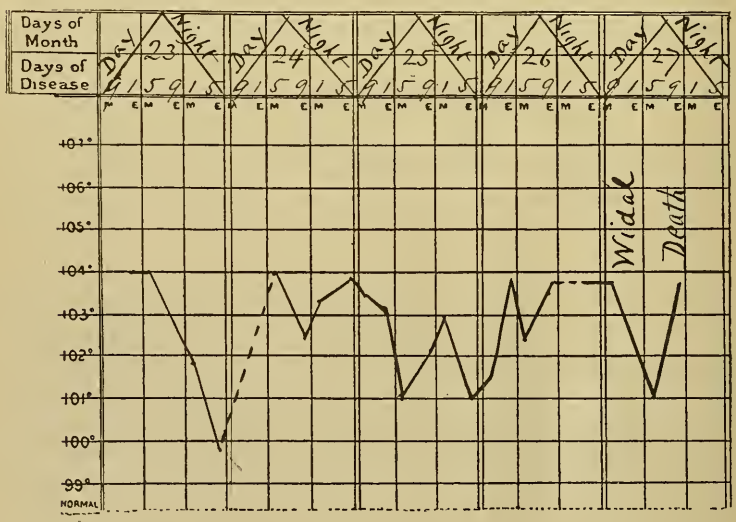


CHART 3.

of greenish-yellow matter. No chills. Slight nose bleed. Insomnia. Delirium. Icteric conjunctivæ. Abdomen lax; gurgling in right iliac fossa. Plasmodia found August 23, 25, and 27. *Positive Widal reaction*, August 27. Leucoytes 18,000. Diarrhea profuse. Delirium intense. Patient got out of bed; died the same day.

The autopsy showed lesions due to malaria, but no typhoid. There was fatty degeneration of heart and kidneys and a hydro-pericardium. Spleen weighed 765 grammes, homogeneous. Markings indistinct. Splenic pulp increased in amount. Pigmentation of spleen and liver. Cultures from heart, spleen, and kidney showed colon bacillus.

In view of the jaundice it is unfortunate that no cultures were made from the gall-bladder, where it is possible typhoid bacilli might have been isolated. The chart is reproduced (Chart III.), showing four hourly observations. Its curve is not inconsistent with the typhoid theory, which was entertained during the life of the patient. The sponge baths with which he was treated were sometimes without effect and sometimes they lowered the temperature two degrees. The leucocytosis noted the day before death may have been a "terminal" one, or else due to the pericardial disease.

Regarding the significance of the Widal reaction in this entire group of cases it must be admitted that its evidence has been in a few cases, puzzling. For example, in Case I., the only one where indisputable proof of a coincidence of malaria and typhoid is at hand, there is reported a negative Widal on September 30, five days before his death, and presumably at least a fortnight after the onset of his typhoid.

Again in the other autopsy case (Case XIII.) a positive Widal reaction occurred on August 27, coincidently with the third demonstration of plasmodia and the day before the patient's death. Yet no typhoid lesions were found.

The possibility of defective technique presents itself in view of the large number of examinations. In neither of the two cases referred to where the Widal test was at variance with the pathological verdict was any confirmation sought from a second test, and in default of that, too much stress cannot be laid on the discrepancy.

Some of my colleagues in view of these and a few other unexpected results from a merely clinical standpoint have been disposed to think that some of the positive reactions reported might have been due to malaria, to quinine or to other causes than typhoid. But we must remember that the wider the experience of the Widal test in thoroughly expert hands, the greater its pathognomic value has been. Cabot[1], in June, 1897, had collected 3,475 cases of typhoid in which the Widal test was positive in 3,434 (98.8 per cent.) and in

[1] American Medical Association.

January, 1898, Brill[1] had collected 4,879 cases with positive results in 4,781 (97 per cent.).

Welsh[2] (June, 1897), after insisting on a rigid limitation of the test to cases in which there was paralysis as well as agglutination of the bacilli, says, "Hitherto, it has not been shown that the reaction ever occurs in non-typhoid serum in a dilution exceeding 1.50." Indeed, he insists that where a typical reaction has occurred, even the evidence of an autopsy as against the presence of typhoid, is not to be taken unless there is also absence of the bacilli in cultures taken from the spleen and gall bladder. In fact, cases have been found in which no lesions existing in the intestine, and a positive Widal being found, pure cultures of typhoid bacillus have been made from the gall bladder. This, by the way, may throw light on an experience which has been had in our hospital of a few Widal reactions in jaundiced patients who did not seem to have, clinically, typhoid fever, the frequency of gall-bladder invasion by the typhoid bacilli having been noted by many observers.[3]

If we accept the summary of this subject formulated at the American Medical Association's discussion (June, 1897) that "without being absolutely infallible the typhoid reaction appears to afford as accurate diagnostic results as can be obtained by any of the bacteriologic methods at our disposal for the diagnosis of other diseases," one may, while admitting occasional errors in the application of the test, assume that a well-marked Widal reaction in our Cuban soldiers, who were suffering from malaria, indicates a complicating typhoid infection.

This evidence, with other strongly confirmatory, indicates that a good many soldiers treated in the hospital had the double infection. In a few cases the evolution of the two infections was simultaneous, but in most, the one morbid process dominated the other for the time, and later the subordinate one reasserted itself.

---

[1] N. Y. Medical Journal, January 8, 1898.

[2] American Medical Association.

[3] See especially articles by Mason, Osler and Councilman. Proceedings Ass. Amer. Physicians, 1897.

XI.

OBSERVATIONS ON PNEUMOHYDROTHORAX AND PNEUMOTHORAX.

By F. H. Williams, M.D.

The following cases of pneumohydrothorax and pneumothorax, chosen from several that I have seen in the past two years, offer some points of interest either of diagnosis or treatment.

They were all examined by me with the Röntgen light, but only one of the patients was in my service; for the others I am indebted to Drs. Buckingham, Cushing and Sears:

PNEUMOHYDROTHORAX.

Case I. — C. P. W., thirty-six years old. X-ray examination, June 5, 1897. When he was examined in a sitting position, the fluoroscope showed fluid in the lower part of the left chest, the surface of which was level, demonstrating that there was air above. The level of the fluid on the left side changed as the patient bent backwards or forwards; when he was gently shaken the splashing of the fluid was clearly seen, and when quiet the waves made on its surface by the heart-beat were visible. The X-ray examination suggested that the patient had also a tubercular infiltration of the right apex. This was confirmed later by the finding of tubercle bacilli. It is necessary to place the Crookes tube and the patient in a proper position in order to show the presence of both air and fluid, for when this patient was examined lying down with the Crookes tube under him, the appearances seen in the fluoroscope were similar to those found in pleurisy with large effusion, because in this position the fluid gravitated to the back of his chest. In pleurisy with a moderate effusion this dark area in the lower part of the chest shades off into the lighter lung area above; the fluid remains near the diaphragm and changes its position comparatively little therefore. On June 17, Dr. Buckingham withdrew thirty-nine ounces of fluid from his chest; on June 29, forty-five ounces; on August 6, sixty-four ounces. He was discharged from the hospital September 25, 1897, improved. He had gained fifteen pounds.

Case II. — The second case of pneumohydrothorax was a patient of Dr. H. W. Cushing — A. B., a boy fourteen years old, who was injured in the chest. He entered the hospital in a state of collapse.

X-ray examination two days after entrance, showed when the patient was in a sitting position, signs similar to those shown in the diagram (Fig. 1), but a little more of the heart could be seen on the left side, and a movement of the diaphragm of about half an inch could be followed indistinctly through the fluid, and above the nipple on the left side the chest was darker, due, probably, to the shadow

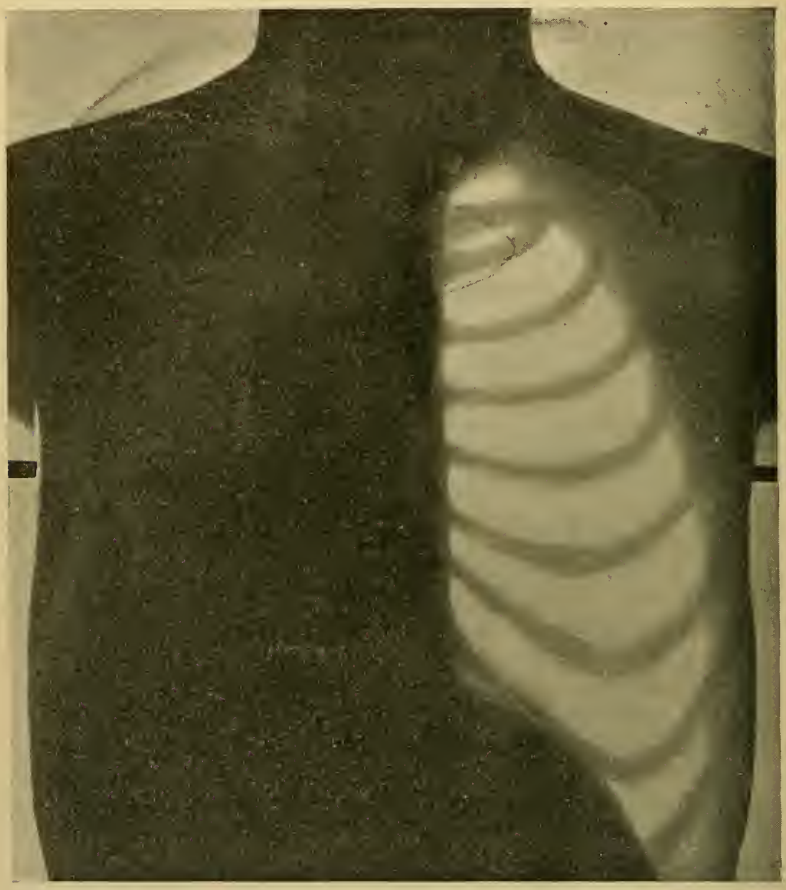


Fig 1. Pneumohydrothorax. Left side.

This diagram was made from a patient not described in this paper, but the appearances in C. P. W. were similar to it, except that the right apex was darker because of a tubercular deposit.

In A. B. the appearances were similar to those in the diagram, except that the outline of the diaphragm on the left side could be faintly seen through the fluid, and the upper part of the left side of the thorax was darker than shown here.

cast by the collapsed left lung; on the right side, although the lung area was somewhat darker than normal, the movement of the diphragm of one and a quarter inches could be readily followed; the right border of the heart was seen distinctly nearly in the right nipple line.

PNEUMOTHORAX.

Case III. — This patient entered the service of Dr. Sears August 30, 1896 — D. C., twenty-eight years old. Alcoholic. On August 29, 6 P.M., he felt a sudden pain in the left side, no dyspnea. On August 30, slight dulness all over right back and axilla. Respiration nearly absent. Fremitus and voice sounds not increased. Left lung negative.

Heart; apex, area and sounds normal.

September 2. In upper and lower thirds of right chest, front, there was tympany and marked amphoric respiration. In middle third there was an area of very distant indistinct respiration. Right supraspinous fossa markedly amphoric.

Physical examination on September 3: Tympanitic note over whole of right front, amphoric respiration marked at right base with metallic tinkling. Over upper and lower thirds of right front, axilla, and right base marked amphoric voice and whisper. Edge of liver could not be felt. Heart dulness a finger's breadth to left of sternum, apex beat in the fifth space one and one-half inches outside nipple line.

X-ray examination September 4: Whole of right side, a clear and bright area which extended far down and over to the left side. Diaphragm on right side extended nearly to the lower costal border; its motion on inspiration and expiration was much limited; its median end had more motion than the outer end. The appearances on the left side were unusual, there were two bright areas divided from each other by a vertical dark area. The heart was pushed far to the left with the lung and vessels. The examination was not complete as the patient was not strong.

September 5, physical examination showed that the apex beat was in the fifth space, one and three-quarter inches outside the left nipple line. Patient rather cyanotic, respiration somewhat hurried. Right chest somewhat more prominent than left, but moved well with inspiration. Metallic tinkling was absent. Edge of liver could not be felt, as patient held himself very rigid.

September 6. The patient had been more delirious since last note, had required constant restraint. Heart's action tumultuous; cyanosis had increased; had been rapidly failing since morning; respiration was more hurried. Pulse failed and he died at 3.10 P.M.

The displacement of the heart and lung was so much greater in this patient than is found in patients with a permanent opening in the chest, as after an operation for empyema, that the air in the

right side of the thorax was probably under more than the atmospheric pressure, and been pumped into the pleural sac through a valve-like opening.

Case IV. — Delia H., twenty-five years old, entered my service at the hospital, April 3, 1898. Alcoholic. Had had much cough and expectoration. One week ago she had suddenly a sharp pain in the left side, which increased. She was unable to take a deep breath.

Physical examination: cardiac area not determined, chest hyperresonant. Apex not determined. No cardiac sounds heard to the left of sternum. On right of sternum heart sounds are heard indistinctly, loudest in fifth space, sternal border, no murmur detected.

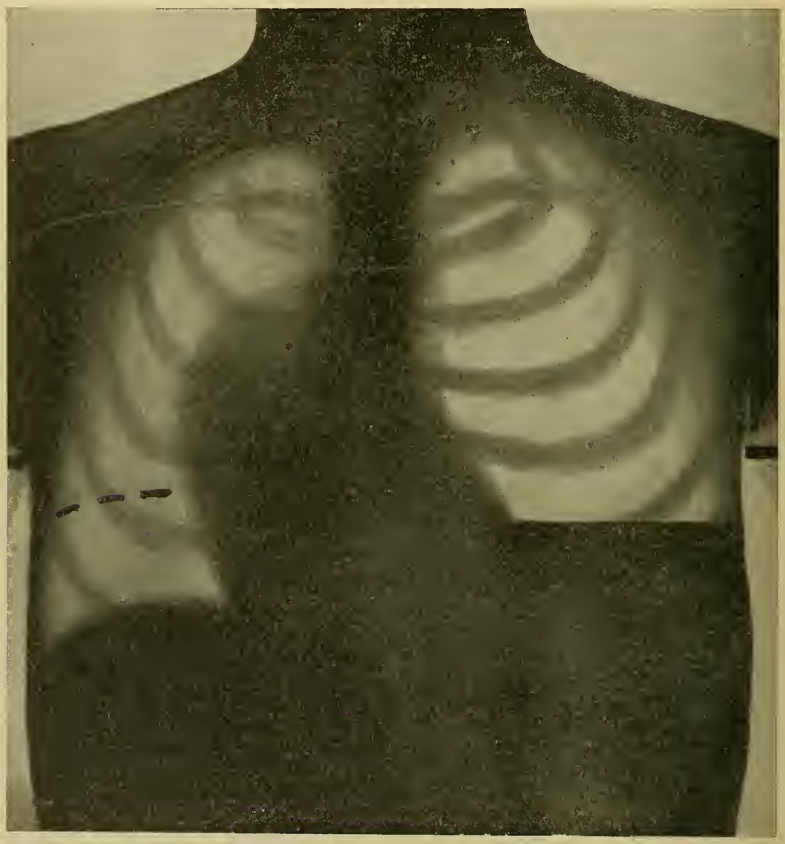


Fig. 2. Pneumothorax on left side and Tuberculosis on right side.

The heart and left lung are displaced to the right. The right side is dark on account of this, and also from the presence of tubercular deposit in the right lung.

Lungs. — Resonance increased over entire left lung, front and back. Tactile fremitus and voice sounds were decreased over this area. Over right back there was marked resonance, and respiration was broncho-vesicular. Many crackling râles were heard. Over right front resonance was fair. Respiration was here accompanied by many râles.

April 4, physical signs the same as on April 3.

X-ray examination was as shown in Fig. 2. After this examination I immediately decided to draw off a part of the air. Knowing how much relief is obtained in cases of pleurisy with effusion when the first part of the fluid is drawn off, I decided to tap the chest and a quart seemed to me a suitable amount to withdraw, for to take out too much might cause the opening from the lung to the pleural sac to open again, and thus require a repetition of the operation. The method adopted was as follows: I sent for a large bottle and a stopper with two holes in it. The bottle was then filled with water and placed on a table near the patient. Through one of the openings in the stopper a glass rod was inserted which reached to the bottom of the bottle, and to whose upper end was attached a rubber tube long enough to connect with a measuring glass on the floor. This tube acted as a siphon to suck the water out of the bottle. The other opening in the bottle was connected by means of a rubber tube with a small hollow needle. The sterilized needle was inserted into the left pleural cavity in the sixth space in the mid-axillary line, and as the water was drawn out of the bottle by the siphon, air from the patient's chest was drawn in. When a quart of water had been thus withdrawn from the bottle and a quart of air taken out of the patient's chest, I lifted the siphon tube until water no longer flowed through it, and, as at this height the siphon had some suction power, I knew that there could not be a free opening between the pleural sac and the air in the lung. The immediate improvement in the patient's condition was very marked. Just before the operation the breathing was shallow and rapid (forty-four per minute); when the aspiration was stopped it was slower and deeper (thirty-five per minute), and soon after this the respirations had come down to twenty-eight per minute. Not only was her breathing made easy, but her color and circulation were improved. Her change for the better was very prompt and permanent, so far as concerned the pneumothorax.

On April 8, a second X-ray examination showed a respiratory excursion of the diaphragm of one and one-fourth inches, and the left border of the heart one and three-fourth inches to the left of the median line. On April 13, a third X-ray examination showed a further improvement, especially on the right side, where the right border of the heart and movements of the diaphragm could be dimly seen.

On April 20 and 28, X-ray examination showed still further improvement.

On April 28 she was discharged from the hospital. The right side of the chest remained always much darker than normal, owing to an extensive tubercular deposit in that lung.

On May 16 she returned to the hospital, and reported that she had been feeling very well up to May 13.

Physical examination showed dulness and many râles of every variety over entire right chest; over lower part of left chest was dulness and absence of voice sounds. Upper part of left chest was hyper-resonant, but respiratory sounds were present and distinct. Tubercle bacilli found in sputum.

May 17, an X-ray examination showed a dark right chest and signs of pleurisy with some effusion in the left chest; a little clear fluid was withdrawn from the left side.

These patients show, I think, that the X-ray examinations may assist us to determine the exact conditions present in this class of cases. I have never appreciated them so clearly, especially in pneumothorax, as by means of an X-ray examination. In treating pneumothorax where there is much displacement of the thoracic contents owing to the drawing in of air through a valve-like opening in the pleura two things may be done. First a suitable and measured quantity of air may be drawn off; second the integrity of the pleural sac may be tested; if it is not intact it may be necessary to repeat the operation, or an opening may be made in the thoracic wall.

XII.

SYRINGOMYELIA: GLIOMA OF THE SPINAL CORD. LAMINECTOMY.

By William N. Bullard, M.D.

The relative infrequency of cases of intrinsic tumors of the spinal cord and the difficulties often attendant on their diagnosis render it desirable that we should record for the present at least such as we can observe with even moderate care. The symptoms of cavity formation in the spinal cord have on the other hand received so much attention in literature of late and have been so fully described that it would scarcely have seemed worth while to present another case were it not that it differed in certain repects from the more usual types of the disease. In the study of syringomyelia, an affection which may be accompanied by so many and such various symptoms, and in which individual cases vary so much in symptoms and causes, it seems to us important that as large a number as possible of the atypical cases should be reported in order that we may settle more firmly those symptoms which are essential or suggestive for the diagnosis of this trouble, and may learn what forms exist and under what disguises it may appear.

The patient, a painter, thirty-three years old, a native of Ireland, came to my office on November 11, 1897, with the following history:

The family history was absolutely negative.

The patient himself had always had excellent health until the advent of the present trouble, with the exception of an attack of gonorrhœa nine years ago followed by stricture. He denied syphilis. He used alcohol in moderation, but never to excess.

The first symptoms of the present affection had appeared three years previously, in 1894, and consisted in retention of urine followed by incontinence thereof, and an inability to retain feces, so that he would at times soil and wet his clothes or his bed. These conditions had gradually, though slowly, become worse, and during the past year he had had tickling or prickling sensations in the soles of the feet, a sense of constriction around the waist, at the level of the umbilicus, and dull pains in the legs. The two latter symptoms more marked since March, 1897.

In June, 1897, the patient went to the department for Diseases of the Nervous System at the Boston City Hospital, where the following condition was noted:

Head and face normal. Sight good. Pupils equal, react to light and accommodation. Heart negative. Spine normal. Upper extremities not remarkable; no marked incoordination. Dynamometer R. 65; L. 68. No atrophy.

Lower extremities normal in appearance, of good size. No tenderness in calves or over tibiæ. Knee jerks rather increased. Tendency to ankle clonus on the left. Considerable weakness in flexion and extension of legs.

The patient at this time was given mercury and iodide of potassium, under which he improved temporarily so that in August it was noted that his legs seemed stronger. Shortly after this, however, he found it necessary to use crutches, and in September he lost the power of walking.

At the present time (November 11, 1897) his pains which had been very severe in the region of the lower intercostal nerves have wholly ceased. The paresis of sphincters continues, and that of the lower extremities is such that he can only walk with the aid of two persons. Numbness of the left hand and both legs to knees.

Since September the patient has been growing distinctly worse. He has lost much flesh and strength, and he has had a number of severe chills.

The physical examination now shows a diminution of sensation to touch and pain everywhere below the level of the fifth intercostal spaces in front, and that of the sixth dorsal spine in the back. There is diminution of sensation over

the whole of both lower extremities, though the exact degree of diminution varies in different parts. The knee jerks are increased. There is ankle clonus well marked on the left, slight on the right. No muscular spasm.

Patient was advised to enter the City Hospital at once and was admitted to Dr. Gay's service, on November 12, 1897.

November 14, 1897. Examination of the sensation for touch and pain shows the upper border of the area of diminution as before. This diminution is well marked below this level over the whole trunk. Sensation reappears at the right groin, and is fairly good over the whole right lower extremity. Though still slightly diminished, more so on the leg than on the thigh. It is markedly diminished over the region of the patella and along the crest of the tibia on the left leg and somewhat so along the inner surface of the left thigh and leg. On the whole, sensation is less good over the left lower extremity than over the right. It is delayed everywhere over both.

November 30, 1897. General condition has been growing worse. The chills, with high temperature, which he has had for a year and which are supposed to be due to malaria, have continued, and he has had more or less vomiting and at times persistent hiccough. Mercury and iodide which have again been given have produced no benefit in the spinal symptoms.

The urine shows a slight trace of albumen, and occasional hyaline and fine granular casts. No sugar. Acid. Specific gravity 1,012.

The physical examinations have shown no special change in the conditions. The eyes were examined by Dr. Jack and the fundi were found normal. Enlarged glands exist in the groins, in the left epitrochlear and right posterior cervical regions. The reflexes in the upper extremities are normal. On account of the serious general condition of the patient and the rapid increase of the paraplegia the question of laminectomy was carefully considered. At the patient's request it was finally determined that this should be done, and on the 30th of November it was performed by Dr. Munro.

The dorsal spines of the third, fourth, fifth and sixth dorsal vertebræ were removed with portions of the laminæ and the dura beneath exposed. Nothing abnormal was detected outside the dura. The dura was then opened longitudinally from the level of the fourth to that of the sixth vertebræ spine. There was no blood beneath and no excess of fluid. The pia was much thickened and more or less attached to the dura by stringy adhesions. The dorsal vein of the cord was much congested. No evidence of tumor or of external pressure of any kind. The adhesions between the dura and pia were separated so far as they could be readily reached. The dura sutured and the wound closed.

The next day the temperature was low and the patient's condition good.

December 4. Patient thinks motion and sensation in legs has improved. Has control of bladder. Bed-sores over sacrum and left trochanter.

December 8. Very sick. Considerable *pain* in lower extremities. Chills. From this time the symptoms remained much the same, though the general condition varied much in appearance from day to day. At times he would have great pain in the lower extremities and could scarcely bear the weight of the bed-clothes. Irregular chills were frequent, with temperature at times as high as 104°–105°, then rapidly descending to 100° or less. Septicemia. Death, January 29, 1898.

PATHOLOGICAL REPORT. BY DR. JOHN J. THOMAS.

Autopsy, January 30, 1898.

Small incision in back was all that was allowed. Body of a man about thirty-five years of age. Well developed and fairly well nourished. Bed-sores over back and buttocks. In the dorsal region over the spinous processes was a linear scar about 10 cm. long. Beneath this the spinous processes of three or four of the upper dorsal vertebræ were absent. On laying open the spinal canal the laminæ over this portion of the dorsal cord were to some extent absent, and were replaced by very dense fibrous tissue. The spinal canal was completely filled by the distended dura. On slitting up the

dura in situ the cord was found to be enlarged and closely applied to the dura, which was adherent to it over the dorsal and lumbar regions. The pia in this part of the cord was much thickened, fibrous and edematous. The enlargement of the cord began about 7 cm. above the cauda equina and extended up as far as the cord could be removed in the cervical region. Section of the cord in the cervical region showed two cavities, each several centimetres in diameter, occupying apparently that part of the cord where the gray matter ordinarily belongs. At the lower end of the cord there seemed to be swelling and edema around the central canal for an area of two or three millimetres.

The cord was hardened in formalin, and divided into sixteen pieces, numbered from above downward from one to sixteen. In the first two sections there were two cavities, one in each lateral half of the cord. The larger was nearly circular, and was filled with a loose-fitting white plug; the other cavity was crescent-shaped. About these cavities was a band of more translucent tissue, sharply marked off from what remained of the white substance of the cord, which lay at the periphery of the cord. There was no trace of the normal gray matter of the cord. These cavities grew smaller in the next section, and at the fourth section the smaller has disappeared. In the next three sections there were no cavities, but the centre of the cord was occupied by an irregular, oval, tumor mass, differing in color from the normal substance of the cord, and spotted with dark-brown areas, varying in shape and size. At the eighth level the tumor showed in its centre an irregular cavity. At the ninth level the tumor left free one posterior quadrant of the cord. At right angles to the broad diameter of the tumor there was a narrow cavity. At the next two levels the cavity was larger, and contained a soft, white plug. At the eleventh level the tumor was smaller. At the thirteenth level the cord was more nearly normal in size, and the tumor was confined almost exclusively to the central gray matter, and one lateral half of the cord, and runs down in one posterior horn, nearly to the periphery. There is the same single cavity. At the fifteenth level, both anterior horns and one posterior horn

were distinct. The tumor lies between the posterior septum and the posterior horn, extending as far forward as the anterior horn. The cavity has ended. At the sixteenth level the tumor is quite irregular, and appears only as dark-brown areas, similar to those spoken of.

Sections were stained by phospho-tungstic acid hematoxylon, by Van Gieson's stain, by the methods of Weigert, and Pal, and by Mallory's method for neuroglia. Sections from the sixth level showed great thickening of the dura and of the connective tissue septa penetrating the cord. The nerve roots appeared normal. The cord itself showed a narrow border only of nerve fibres, which were greatly and diffusely degenerated. There were still a considerable number of normal nerve fibres in the posterior columns and on either side of the anterior fissure. A few fibres from the posterior roots could be traced into the substance of the cord, where they mingled with some coarse fibres, which ran longitudinally and represented the fibres of the posterior horn. The anterior horn was represented by a few large ganglion cells, on either side of the anterior fissure, near the periphery of the cord. The whole central portion of the section was taken up by a gliomatous neoplastic growth in which were a considerable number of nerve fibres. There were also numerous fibres of the anterior commissure remaining, but with these exceptions none of the normal elements of the cord could be made out. The structure of the tumor varied considerably. In places it consisted of thickly packed neuroglia cells with few fibres, while in other places the neuroglia fibres predominated and formed a dense network. The cells had a non-granular protoplasm which was small in amount, and large, oval vesicular nuclei. In places were groups of other cells, which varied considerably in size, some as small as lymphoid cells, while others were three or four times the size of epithelioid cells. They had finely granular or homogeneous protoplasm, and very small, deeply staining nuclei. The cavities already mentioned were seen to be cavities in the gliomatous tissue, which were irregular in shape and in the character of their borders. In places the wall was composed of a thickened border of neuroglia, while in other places there was no regular or

definite wall, and the neuroglia fibres extended broken off, into the cavity. In places the cavities were filled with dense masses of fibrin, and fairly numerous pus cells, while there were innumerable streptococci everywhere. There was no sharply defined abscess formation, though pus cells were numerous. There were also large hemorrhagic areas. Nowhere was there any trace of the central canal, nor had the cavities any epithelial lining. The nerve cells seen in this section and those from higher levels appeared homogeneous and flattened. Sections from the first level showed a dense mass of neuroglia beneath the bifurcation of the septum running into the cord in the anterior fissure, in which there was embedded a collection of epithelial cells. This represented the central canal, and was the only trace of it that appeared in section. This group of epithelial cells had no relation to the cavities in the tumor.

In sections from the fifth level there was no one large cavity, but in the centre were seen three or four small cavities with walls of thickened neuroglia, which appeared to communicate at other levels with one another. Sections from the seventh level showed the central cavity filled by a fibrinous plug. There were innumerable streptococci in this. The tumor was represented only by a narrow ring of glia cells and fibres. Sections from the eighth level showed a large area of hemorrhage into the gliomatous tissue. In sections from the thirteenth level the normal gray matter was made out to a great extent. There were numerous ganglion cells in both anterior horns. There was much less degeneration of the nerve fibres than at higher levels. The areas where the degeneration was most marked were in the anterior part of the cord at its periphery, and in the lateral pyramidal tracts, while the posterior columns, and the antero-lateral tracts were normal. The nerve roots showed some diffuse degeneration. There was a collection of degenerated pus cells with a few lymphoid cells just at the edge of the anterior horn. This was about a blood vessel and probably represented a partially degenerated inflammatory exudate. The endothelium of some of the arteries of the pia was elevated by collections of pus cells as occurred in inflammations of the pia. At the sixteenth level the cord appeared fairly normal,

except that in one posterior horn there was a large but fairly circumscribed hemorrhage, corresponding to the pigmented area already spoken of. This was surrounded by a very cellular gliomatous tissue occupying a small part of the posterior columns pushing one of the posterior horns to one side, and extending up into the gray matter almost to the base of the anterior horn of that side. There were many large vessels in this region. The central canal could not be made out. The invasion with streptococcus was marked. There was some diffuse degeneration in the white matter.

Diagnosis. Glioma, and diffuse gliosis of cord with cavity formation. (Syringomyelia.) Streptococcus abscess of cord.

The symptoms of our patient began more than three years before the fatal ending, with retention of urine followed somewhat later by the involuntary passage of urine and feces, due apparently, in part at least, to loss of sensation in the region of the sphincters, as these discharges occurred frequently without the patient's knowledge.

It was not until nearly two years after the onset of the bladder symptoms that the patient seems to have had much pain. He then had severe pain, which he called "neuralgia," in the head and shoulders and later about the middle of the back. These pains were nearly constant, sharp at times, but more often a dull ache. Gradually the pains in the back encircled the body about the level of the umbilicus and became girdle pains. Numbness now began to develop in the feet and legs. Weakness of the lower extremities, which began almost imperceptibly, increased somewhat rapidly in the course of the summer of 1897 (third year of the disease) so that in the autumn of this year there was marked paresis of these extremities and he could walk only when supported by two persons. The knee reflexes were increased and ankle clonus gradually appeared.

About the time of the development of the pain the patient had chills, which continued at intervals until his death.

In September, 1897, the general health of the patient failed rapidly and he developed bed-sores and died with symptoms of sepsis in the following January.

In considering this case we wish in the first place to draw attention to the absence of certain symptoms. There were at no time any symptoms referable to the brain. There were no convulsions, no affections of the cerebral nerves, no ocular lesions or pathological symptoms of any kind. There was also no tremor anywhere in head, limbs, or body. There were, moreover, no abnormal signs or symptoms in the upper extremities which, contrary to what so often occurs in syringomyelia, showed no atrophy, no trophic lesions of any kind, and gave no evidence of any anomaly of sensation except a temporary subjective numbness of the left hand. There was also in this patient no scoliosis, one of the most frequent symptoms of certain forms of syringomyelia.

In the lower extremities we note the absence of atrophy or of any trophic disturbance.

Sensation in this patient when first carefully examined for touch and pain was diminished in front below the level of the fifth intercostal space and over the back below the level of the spine of the sixth dorsal vertebræ. Below these levels a marked diminution existed as low as the groins and buttocks, where the sensation became again relatively good. Over the lower extremities sensation to both touch and pain was everywhere delayed. On the other hand, the loss of sensation varied much in different portions of these limbs; in some parts the sensation seemed essentially normal, while in other parts, especially near the patella and over the anterior surface of the left leg, it was markedly diminished.

I regret much that no record was made of the temperature sense in this patient. We have, however, no reason to suppose that any severe affection of this sense existed outside of the area of diminished sensation. Neither was there any evidence of any marked change in this sense in the lower extremities.

Cases of syringomyelia in which, as in the present case, the diminution of sensation involved essentially the same area as that occurring in transverse myelitis or in bilateral pressure of the cord, that is all the surface of the body and limbs below a certain level, have been reported, and this form of the area of diminished sensation has been supposed to occur more

especially in the later stages of the disease where much destruction of the cord had taken place either from hemorrhage or from new growth.

The diagnosis of this case presented certain difficulties. Previous to November, 1897, when he first came to my office, he had apparently presented chiefly the symptoms of a chronic myelitis and the diagnosis of a chronic syphilitic disease of the spinal cord had seemed justifiable. At that time, however, it seemed to me that this view could not be substantiated. Tumor affecting the spinal cord was suspected, and he was sent to the hospital with a view to further observation and possible laminectomy. After careful examination and observation in the hospital it was decided that the condition did not warrant the diagnosis of a removable tumor either pressing upon or seated in the substance of the spinal cord and that laminectomy could not be urged. Nevertheless, as the probable diagnosis seemed to be tumor of the cord and as a removable tumor could not be excluded the patient was informed that an exploratory laminectomy would be performed if after an explanation of the conditions he so desired. At his request, therefore, the operation was performed.

The differential diagnosis between chronic syphilitic myelitis and tumor of the cord was made in this case largely on account of the course of the disease. It would be extremely unusual in a syphilitic myelitis to have the bladder and rectal symptoms so long precede those of sensation and motion. It would be also very unusual to have a patient who had had a chronic syphilitic myelitis for two or three years have such a sudden increase of symptoms with so serious a general condition occurring in the course of a few weeks and not of sudden onset. Schlesinger (Die Syringomyelie) says "the differential diagnosis between primary gliomatosis and acute or subacute myelitis is generally very difficult. Hoffmann has collected the most important considerations for the differential diagnosis, and I repeat them according to Hoffmann's statements. The tendon reflexes are generally permanently exaggerated in transverse dorsal myelitis, in gliomatosis they are often exaggerated in the

beginning, then lose in activity, and finally vanish. Muscular tension in the legs seem to be more marked in dorsal myelitis, but is almost wholly wanting in many cases of gliomatosis. I will, however, remark that I have already cases of cerebral tumors of the spinal cord (glioma) in which the rigidity of the lower limbs took a front rank in the clinical symptoms (in den Vordergrund des klinischen Interesses treten)."

The value of sensory dissociation symptoms we do not place very high. It is well known that such symptoms may exist in many affections besides syringomyelia, even in multiple neuritis and tabes. Many years ago I found distinct dissociation symptoms in a case of sarcoma of the spinal vertebræ. I should have been glad, however, if detailed reports of the condition of the sensation in the earlier of the stages of the disease could have been obtained.

I beg to express my thanks to Drs. Gay and Munro for their kind permission to use the surgical records in this case.

XIII.

CASES OF ACUTE ABDOMINAL INFLAMMATION.

By John C. Munro, M.D.

The following cases of acute affections of the abdominal cavity, although occurring under the immediate care of the writer, and therefore representing only a small proportion of all similar cases, illustrate fairly well the problems that confront the members of the staff in their daily work. No cases of appendicitis are included, but it is fair to say that on the theory of chances, many of the operations were undertaken in the belief that the symptoms were due to inflamed appendices. In order to illustrate certain types a few cases from outside the hospital have been included:

A. twisted cyst-pedicles.

1. Annie K., twenty-nine years old, entered the hospital in Dr. Gay's service with an indefinite history of pelvic trouble for two or three years; the present trouble began six days ago with pain, vomiting, obstipation and distention. At entrance she was seriously ill with distention, spasm, and a tumor to be felt over the pubes and by the vagina.

Operation at once. Ether. A dark purple ovarian cyst of the size of a fœtal head was found twisted from the left side to the right through 180°, and lying behind the uterus. In addition to a strangulated cyst, the tube and broad ligament were also strangulated close to the cornu. The cyst pedicle was transfixed and tied off, and the tube and broad ligament transfixed in the same way, but through strangulated tissue, as close to the uterus as possible and removed. The abdomen was flushed out and drained. The patient stood the operation only fairly well, and stimulation was freely used. On

the following day she was comfortable, but the distention increased in spite of cathartics, etc., and she died on the second day.

2. Susan D., twenty-seven years old, entered the hospital in Dr. Burrell's service with an acute peritonitis that quieted down under hot applications. She gave a history of frequent attacks of abdominal pain since her last child was born, five months ago. Examination showed a median tumor extending to the umbilicus, tense and elastic and tender low down on the left side. No definite symptoms of pregnancy were found.

Operation. Ether. Fresh, quite soft adhesions were found everywhere; the cyst contained a thin, claret-colored fluid. The pedicle was twisted close to the cornu on the right side, from right to left, one and a half times. The thick, boggy tube lay firmly adherent to the cyst on its right and anterior surface. There were thickened patches of lymph on the intestines; elsewhere the peritoneum was hemorrhagic and opaque. The wound was partially closed, drainage and provisional sutures being placed in the lower portion. Calomel was ordered at once. Recovery was uneventful.

3. Miss ———, twenty-five years old, was attacked ten days before entrance to Dr. Gay's service with dysentery; then she had several chills followed by moderate tenderness and spasm over the appendix. Examinations of the urine and blood were negative. The spasm and tenderness disappeared for a few days, when the temperature and pulse began to rise, and the night before operation she had a marked chill. Examination showed close to the umbilicus on the right, a slightly tender tumor of the size of an egg, but no abdominal spasm, and after the patient was under ether the tumor had disappeared.

Operation. Ether. Incision over the place where the tumor had been felt. An irregular, thin-walled, multilocular cyst of the size of a large hen's egg was found lying in the broad ligament close to the outer third of the tube; it was freely movable, even up to the umbilicus, with a long pedicle of tube and ligament, and showed evidence of previous inflammation. The tumor was removed, and the abdomen

closed layer by layer. Calomel was ordered at once. Recovery was uneventful.

4. Emma L. M., fifty-one years old, was seen with Dr. H. C. Valentine. She had had for several years attacks of so-called "bilious turns." Four days before operation symptoms of appendicitis appeared, but without being serious enough to cause alarm until the night before operation. All the signs and symptoms then pointed to an acute appendicitis with abscess formation.

Operation. Ether. A large, purplish-black dermoid cyst was found lying on the cecum and ascending colon; at the pelvic end was the black, gangrenous Fallopian tube. The cyst was rotated once to one and a half times from right to left, the twist taking place close to the cornu. The intestines were distended and injected. The wound was partially closed with drainage. Calomel was ordered at once. Recovery was uneventful.

B. PERFORATING GASTRIC ULCER.

5. Jessie S., twenty-one years old, had complained for several years of more or less constant pain and distress in the stomach, but without any vomiting of any kind. Four days before operation the pain grew worse, but she kept at work until the day before entrance, when the pain became suddenly very severe, with a chill and vomiting. The vomiting ceased shortly, but the abdomen began to distend and the pain to increase. At entrance to Dr. Gay's service she was in severe shock and much distended.

Operation. Ether. Incision one inch to left of median line over the stomach, enlarged later to the right. On opening the peritoneum which was thickened, gas and stomach contents were found in the general cavity. A round, punched out opening, barely admitting the tip of the finger, was found at the pyloric end close to the lesser curvature. Around the ulcer there was a circular plate of diphtheritic-looking membrane, and the walls of the stomach felt brittle and infiltrated. An attempt was made to suture the ulcer, but the walls were too soft and the sutures cut out at once. Then the pyloric end was drawn forward as far as was deemed safe, until the

ulcer touched the inner wall of the parietes, and there sutured to the wound with silk. The general cavity was then flushed out with hot, sterile water, but it was realized at the time that the abdomen was not thoroughly cleansed. Iodoform wicks were then packed in, walling off, entirely, the region around the ulcer, and glass drains were passed into the region of the spleen and the foramen of Winslow. A rubber tube was tied into the stomach through the ulcer and conducted outside the dressings.

The patient stood the operation fairly well and stimulation was used freely. Calomel, to be injected through the rubber tube, was ordered at once. On the following day a good stool followed an enema; she felt and looked better and the distension had not increased. On the second day the wound was dressed; there was a profuse discharge and a larger tube was placed in the opening. The patient looked much better, and had no distention nor vomiting. On the third day, at the dressing, some of the wicks were removed; the skin was found quite macerated. The patient remained in excellent condition until the same evening, when she suddenly collapsed and died after a few hours of acute peritonitis.

Autopsy showed a large pocket of pus in the pelvis. There were several spots of localized peritonitis, but they were small. The ulcer seemed to be well walled off from the general cavity.

Had the abdomen been thoroughly cleansed at operation and the pelvis drained, probably the patient would have lived.

6. Mary E. G., twenty-one years old, had had dyspepsia for several years; five weeks ago she had coffee-ground vomiting; two weeks ago she had severe pain in the left side of the abdomen; this disappeared, and returned on the following day. She was then fairly well until four days ago, when the pain returned as before; since then it has been constant and there has been general abdominal tenderness. Vomiting, but without blood. At entrance to Dr. Gay's service there was green, profuse vomiting, general abdominal distention and spasm, and probably a pneumonia at the base of one lung.

Operation. Chloroform. Under full anesthesia spasm was more marked above the umbilicus; also an edema of the entire wall was more marked in the same region. Upon opening through the thickened peritoneum, gas, pus and gastric contents escaped. An opening in the cardiac end of the stomach close to the edge, of the size of a lead pencil, was found, with thickened cheesy edges. This was closed with a mattress and straight silk sutures, and over all the healthy wall was sutured to give additional support. The general cavity was then flushed out with gallons of hot salt solution; where possible, adherent lymph was cleaned off of the intestines and liver. Most of the lymph was in the upper part of the cavity, although there was vomitus in the pelvis and flanks. The wound area was packed with gauze and a glass drain, the abdomen filled with salt solution, and the patient put to bed with the foot elevated eighteen inches. On the following day the patient was no better, gradually lost ground and died about forty-eight hours after operation. No autopsy was allowed, but an examination of the abdomen showed that there had been no leakage, the wicks being clean and dry.

C. VOLVULUS.

7. Edith H., twenty years old, had had several attacks of severe peritonitis in the last few years. Three weeks ago she was suddenly attacked with sharp abdominal cramps, faintness, vomiting and distention; the vomiting has continued and she has been very ill. On the day of entrance to Dr. Gay's service there was an exacerbation of pain, and her physician sent her to the hospital. At admission she looked very ill, with a dirty, red tongue, sordes, a distended abdomen resistant only on deep pressure (she had been given morphia in unknown quantity before admission) and rigidity most marked over the appendix. The wall was markedly edematous.

Operation. Ether. Median incision. In the right lower quadrant was an irregular mass slightly adherent to the iliac fossa and brim of the pelvis. After freeing the adhesions the mass could be brought to the surface and was found to consist of a strangulated loop of ileum that had been torn

from the distal portion which lay firmly adherent to the edge of the pelvis. Through the torn gut feces escaped. The intestine had evidently been strangulated by a twist or possibly by old adhesions. Some gangrenous gut was resected and the proximal end sutured into the upper angle of the wound. The distal portion could not be brought up for anastomosis without prolonging the operation too long, nor would the condition of the patient allow any further interference, so the lower end was drained through the lower angle of the wound by a rubber tube and gauze wicks. The middle of the incision was closed with sutures, a piece of rubber cloth was sutured to the false anus and the lower angle dressed with gauze. Much feces escaped during and after the operation with marked relief to the distention. The patient was very weak throughout, but recovered well from the ether, but the pulse continued rapid and weak, and death followed twenty-fours hours after operation. No autopsy was allowed.

D. INTESTINAL BANDS.

8. Annie C., thirty-three years old, had a cystic ovary removed five months previous to her present trouble, and from the history obtained there was probably some sepsis following the operation, although the wound was closed without drainage.

At entrance to Dr. Cushing's service the patient had not had a stool for eight days, and had been vomiting for three days. The abdomen was not distended, but somewhat resistant, and the peristalsis could be easily seen through the walls. Two large enemata brought no result. The patient refused operation at first, but six hours later the pulse having risen, and the vomiting and distress having increased, she consented.

Operation. Ether. All about the old scar the intestines were adherent to the parieties and to each other, and in several places a loop would be adherent to itself, making a sharp angle, but without constriction enough to account for the obstipation. After freeing a number of adhesions of various degrees of thickness, a short, tough band was found

passing from the convexity of a loop to its mesentery, and constricting another loop so as to occlude it almost completely; the latter showed evidence of irritation in a thickened, rough, ecchymotic surface. The band was removed, and in other places rough patches were covered where possible, by suturing the peritoneal edges together with fine silk. The wound was closed, and calomel ordered at once. At intervals in the following three weeks the patient had more or less vomiting and abdominal cramps, due as much to nervousness and apprehension as anything, but by the end of five weeks she was discharged in good condition.

9. Mary W., twenty-three years old, had been through two typical attacks of appendicitis within a few months; the present attack began three days ago with severe abdominal pain, a chill, obstipation and persistent vomiting. At entrance to Dr. Gay's service there was increased spasm over the appendix, distention and a general appearance of peritonitis.

Operation. Ether. Incision over the appendix. Towards the median line a tense band, passing from above downwards, and about four inches long, was found; adhering to this was a loop of small intestine, congested, and showing a small patch of lymph. The appendix was found higher up than normal and buried at its tip in old adhesions; it was not inflamed, but quiescent, and on section, later, showed evidence of constriction from old inflammation or adhesions. Further exploration showed evidence of old pelvic trouble, and a thick short band passing from the fundus of the uterus to the sigmoid was removed. The wound was closed and the recovery was uneventful.

10. Emma E., twenty-six years old; was seen at the Quincy City Hospital. Five days previously the patient was taken with abdominal pain, obstipation and vomiting; for two days the vomiting has been fecal. The patient was very ill with a distressed face, rapid feeble pulse, a flat abdomen, not especially tender to pressure.

Operation. Ether. A small band was found passing from close to the umbilicus to the small intestine, and twisted around this was a dark, strangulated loop of jejunum, caught

upon itself and held by adhesions; a smaller inflammatory band was present, helping to constrict the gut also. The gut when freed regained its color. The first band was attached to the gut opposite the mesentery; at its base was a thin walled cyst containing a yellowish, mucous fluid. The operation was done as rapidly as possible, owing to her bad condition. She rallied fairly well, but died in about twenty-four hours.

The possibility of the constricting band being the remains of a Meckel's diverticulum was considered, but the patient was too ill to permit careful examination, and no autopsy was allowed.

11. Miss T., a patient of Dr. F. G. Smith, nineteen years old, a year before operation had an attack lasting six weeks, that was apparently acute peritonitis. A few months later a slighter attack followed and was considered to be appendicitis. The present attack began six weeks before operation, with abdominal pain, vomiting and distention, besides increase of pulse and temperature. Latterly there had been severe attacks of colic, depending entirely upon the passage of gas through a definite region in the bowels. Tenderness had always been definitely referred to a small spot close to the umbilicus on the left.

Operation. Ether. Small opening over the spot of local tenderness. Under the omentum a firm band, two inches long, and looking like an attenuated epiploical appendage, was found adherent to the mesentery of the small intestine, and constricting two loops. A secondary adhesion was found near by. The rough surface was turned in and closed over with fine silk. Careful search failed to find anything else abnormal in the cavity. The wound was closed layer by layer, and calomel ordered at once. Recovery uneventful.

E. TYPHOID PERFORATION.

12. William J. This case was published in the Medical and Surgical Reports of the Boston City Hospital, Ninth Series, p. 126, and need not be recounted again here.

13. John M., an Italian, thirty years old, was under treatment in the medical ward for typhoid at about the

beginning of the fourth week. He had been running a mild course when, at 1.30 P.M., he had a sudden attack of severe abdominal pain, localized in the right iliac region; there was marked collapse, with cold sweat, and the pulse fell to 90°, while the temperature rapidly rose to 105°. There was no nausea, but spasm and tenderness of the abdomen. Admitted to Dr. Cushing's service.

Operation four hours later. Ether. Under full anesthesia spasm persisted on the right at the level of the umbilicus, where the incision was made. Upon opening the peritoneum a small flake of lymph was seen, and upon withdrawing the loop of intestine, immediately beneath the wound, a perforation of the size of a knitting needle, with escaping feces, was found. Owing to the rigidity due to the Peyer's patch, two rows of fine silk sutures were used to close the perforation. The abdominal cavity was flushed out with hot salt solution, and the local area drained with iodoform wicks and a glass drain. As soon as the patient was under ether the pulse rose to 160°, and his general condition prevented any search for further perforations.

On the following day the general condition was excellent, the pulse and temperature having dropped nearly to normal. There was no distention, the patient taking nourishment by mouth without nausea; the dressing was reinforced, as there had been considerable leakage of serum and salt solution.

On the second day he suddenly collapsed, and died forty-eight hours after operation. A partial autopsy through the wound showed only a mild degree of peritonitis in the region of the wound, due to the wicks; no hemorrhage; no fresh perforation; no leakage; nothing to account for death. Chest and head not examined.

F. THROMBOSIS OF MESENTERIC ARTERY.

14. Miss ———, thirty-two years old, contracted a severe cold nine days before operation. She entered the medical ward, with slight abdominal tenderness, and typhoid was suspected. She then became suddenly worse, with symptoms of a general peritonitis, and immediate operation was advised. Admitted to Dr. Cushing's service.

Operation. Ether. Under full anesthesia spasm persisted, being more marked over the appendix, where the incision was made. The entire small intestine was found to be purplish black, and in the mesenteric vessels thrombi could be felt. The wound was rapidly closed, and the patient died in a few hours. Autopsy showed a thrombosis of the entire portal system.

G. PENETRATING WOUND OF RECTUM.

15. Joseph T. M., twenty-one years old, while vaulting over a broomstick, sat upon the end, which entered the rectum. He went to bed at once, and shortly passed by rectum a piece of the clothing that had been carried in ahead of the stick. Pain, distention, obstipation, and bilious vomiting rapidly set in, and forty-eight hours after the accident he was brought to the hospital to Dr. Gay's service, where he presented a markedly distended, rigid abdomen, and an opening just within reach of the finger in the right anterior wall of the rectum, communicating directly with the peritoneal cavity.

Operation at once. Ether. Median incision. The pelvis was found full of feces and lymph, but evidently the process had not invaded the upper half of the abdominal cavity. The perforation lay close to the bladder, in the anterior wall of the rectum, but without injuring the former; the intestines were too much distended to allow any attempt at closing the hole, so an inguinal colostomy was at once made, the pelvis wiped out as carefully as possible, and packed with gauze and a glass drain. Into the inguinal wound some rubber tissue was sutured, in order to block the escaping feces away from the median wound. His condition at the close of operation was precarious, and stimulation was used freely. Calomel was ordered at once.

On the following day he was somewhat better, though distended, so a high enema was given through the inguinal anus with good result. On the sixth day feces escaped through the median wound, but ceased to come that way in about two weeks; and gradually, after about three months from the operation, both abdominal wounds closed, and all the discharges came naturally. Examination by rectum

showed a small scar in the rectal wall, without any evidence of constriction.

H. ACUTE PANCREATITIS.

16. Mary A. M., fifty years old, eight days ago began to complain of trouble in her stomach and heartburn. Five days ago she was suddenly seized with intense pain in the region of the gall-bladder, lasting several hours, and not controlled by large doses of morphia; she vomited several times but there was no blood in the vomitus or stools. Improvement then followed up to the day before entrance, when pain returned in the region about the umbilicus; the bowels which had been without passage of feces or gas for five days, moved freely. At no time had there been localized tenderness, jaundice or renal trouble.

At entrance to Dr. Cushing's service she was said to have lost ground very rapidly within the last twelve hours; she was cyanotic, restless and anxious, and was constantly regurgitating a greenish fluid. The pulse was of fair strength, but rapid; the abdomen was generally distended with moderate spasm and tenderness.

Operation. Under a few whiffs of ether the abdomen was rapidly opened; the respiration immediately stopped, probably from inhalation of vomitus; the pulse, however, continued for a short time to beat. Examination through the wound showed moderately firm, fresh adhesions everywhere, and a moderate quantity of pin-head tubercles in the omentum, mesentery and parietal peritoneum. No focus of septic infection could be found anywhere, and the case was supposed to be one of general miliary tuberculosis. Some tubercles were removed for examination, and they proved to be "Fat necrosis, probably from acute hemorrhagic pancreatitis." No autopsy was allowed.

I. INTUSSUSCEPTION.

17. Timothy W., thirty-seven years old, entered the hospital on Dr. Cushing's service with a history of abdominal pain for sixty hours, obstipation, increasing distention and tenderness. There was fulness and spasm, persisting under full anesthesia, over the appendix, and the case was supposed to be one of appendicitis.

Operation. Ether. An intussusception of the ileum into itself at its lowermost end presented, the length, as measured afterwards, of the invaginated portion being eight inches. The gut, proximally, looked dark, and upon piercing the mesentery with a gauze ligature it tore into the lumen with escape of feces; what appeared to be healthy intestine seven inches from the invagination was used as the upper section of the joint; and the portion one inch from the ileo-cecal valve, but close to the lower end of the invagination was used as the lower part of the joint. The mesenteric vessels were secured by a continuous button-hole suture of catgut along the free edge. An end-to-end anastomosis was made with a single row of silk sutures. The cavity was irrigated out with salt solution and the region of operation drained with gauze and a glass tube.

The patient was in poor condition at the outset, and was much worse at the close of operation, but he rallied under stimulation and salt solution given under the breast.

On the following day he was still very ill, and got up out of bed against orders to pass his urine. Thirty-six hours later he grew worse and died. No autopsy was allowed, but an exploration of the region showed the abdomen to be full of feces from a rupture in the intestine on the proximal side of the joint, which was tight.

It is unfortunate that more of the gut was not resected, but at the time of operation the portion appeared to be viable.

18. Chin Yuen, a Chinese laundryman, twenty-one years old, entered the medical ward October 21, 1898, with a history of paroxysmal pain, principally in the right side of the abdomen for three weeks, with nausea and vomiting; the bowels had been regular. He had been ill also, nine months previously with abdominal pain. At entrance he was in much pain with a lax, tympanitic abdomen, tender to deep pressure and resistent in the right hypochondrium. He steadily improved, however, the vomiting ceased and the pain became less frequent, so that by November 1, he expected to be discharged; but on the following day the pain returned, and fresh blood was passed from the rectum. Nevertheless he did not appear to be very ill until November 4, when the

vomiting became bilious and the pulse began to rise. A tumor could be felt by rectum filling the pelvis, and in the right iliac region. Admitted to Dr. Gay's service.

Operation, November 5th. Ether. Long incision to the outside of the rectus on the right. A long, sausage-shaped tumor was found lying in the right iliac region, extending from beneath the left lobe of the liver to deep in the pelvis. Upon examination it proved to be an intussusception of the jejunum into itself, or of the jejunum and upper portion of the ileum, 12 to 14 inches in length. (Measurement of the specimen in alcohol showed that at least 32 inches had been removed.) Towards the lower end were three gangrenous areas, which ruptured on handling, and allowed pus and feces to escape. The entering end lay close to the liver, and was brought out upon the abdomen for manipulation with great difficulty. The mesenteric vessels were controlled as the gut was removed by a continuous button-hole catgut suture, but as the blood supply at that level is very rich, a number of vessels were tied separately. Hoping to gain a little, the bowel at the upper end was pulled out from the intussucipiens for an inch or two, but after amputation the circulation was too poor in the piece withdrawn, and an inch or more had to be reamputated. To have removed more would have necessitated another abdominal incision to allow access to the stump, so the risk was taken that the bowel would live at the place selected, although its mesentery looked bluish, and in one place had a small inflammatory patch. The lower stump-end was edematous, rigid, and half as large again as the upper end, but an end-to-end anastomosis was made with two rows of continuous right-angle silk sutures.

Although it could not be verified, the intussusception appeared to be a reverse one; that is, the ileum was apparently invaginated into the jejunum.

The abdomen was flushed out with salt solution, a half-pint of the same solution was poured into the intestine before the joint was closed, the lower portion of the abdomen was closed, and the region of the anastomosis packed with gauze and glass drain. The patient stood the operation, which

lasted an hour, fairly well, having a regular pulse of 140° to 160° at the close. Calomel was ordered at once.

On the following day an enema produced a good stool. On the second day he took nourishment liberally by mouth. The wicks were started, and on the fourth day they were all removed.

November 11, the sixth day, intestinal contents, bile, and pancreatic fluid escaped from the wound; otherwise he was in good condition. Then, as he began to lose flesh from lack of nutrition, a second operation was done under ether. As the sinus led obliquely to the opening in the gut behind the linea alba, a new abdominal incision was made directly over the hole. Some time was spent in trying to close the hole without disturbing the rest of the tissues, but the surrounding walls were soft and gangrenous, and no sutures would hold; so the wound was enlarged, the new granulations and adhesions all torn up, and the bowel turned out to make a new joint. The original joint had apparently held the break taking place in the gut that was considered doubtful at the first operation. Owing to the time wasted at the beginning and to the poor condition of the patient, a hurried, rough joint was made with a few mattress sutures. A wick was placed down to the joint for drainage. Considerable shock.

He rallied well, took nourishment well, and seemed to be all right, when, on the sixth day, leakage again occurred. As he was not losing ground, a third operation was deferred for five days, when a small opening, an eighth of an inch in diameter, was found, lying in firm, healthy tissue. This could be easily and tightly closed with some fine silk sutures. The parietal wound, after being curetted, was closed tightly over the deep stitches, with only a capillary drain brought out through the old wound.

Two days later, however, bile and pancreatic fluid reappeared, but as the patient was steadily and comfortably gaining and eating all kinds of food, the sinus was let alone, and in the course of a week or two it closed spontaneously. In a short time it leaked again, but at the present writing the sinus has closed, and the patient is well.

XIV.

AN APPARATUS FOR MAINTAINING POSITION IN FRACTURES OF BOTH BONES OF THE LEG.

By Robert W. Lovett, M.D.

Difficulty is often experienced in preventing over-riding of the bones in fractures of both bones of the leg. Where the line of fracture in the tibia is oblique, the apparatus here

described is applicable, and in use has corrected over-riding where it existed.

It consists of a plaster of Paris circular bandage with provision for making traction upward on the leg above the seat of the fracture and traction downward below the seat of the fracture. The bandage is applied as follows:

A piece of adhesive plaster an inch wide, to the upper edge of which is sewed a piece of webbing, is applied to the outside and inside of the leg running from the seat of the fracture nearly to the knee. Two other strips, each attached to webbing, are applied from the seat of the fracture running downward to the malleoli, where the webbing begins. Diagonal strips of sticking plaster are put around the leg to keep the strips in place. The leg is thus provided with two sticking plaster extensions, one of which can be made to pull down and the other to pull up. The leg is then prepared as for the ordinary plaster, being wound in sheet wadding. Below the sole of the foot is placed a layer of felt or folded sheet wadding the size of the foot and from one to two inches in thickness; a circular plaster bandage is then applied in the usual way, which should run from just above the knee to the sole of the foot including the padding on the sole. This plaster should be applied in such a way as to allow the webbing straps, which pull downward, to come through the plaster near the ankle; this is done by carrying turns of the bandage first above and then below the sticking plaster held at right angles to the leg. The webbing from the upper extension should be long enough to extend above the top edge of the plaster and to leave several inches for turning down; these ends should be secured by buckles sewed to webbing which is incorporated in the outside of the plaster bandage when it is being put on. These buckles should face upward, and should be a few inches from the top of the bandage. After the plaster has hardened a part of the felt or sheet wadding should be removed from below the foot to give space for the foot to be pulled down. The straps attached to the upper extension, which turn over the upper edge of the plaster, are turned down and buckled into the buckles incorporated in the plaster, this furnishes a firm hold on the leg above the fracture. The two straps, which are attached to the lower extension and which come through the lower part of the bandage, are then tightened by pulling down on them and are buckled together below the foot over the plaster. This produces traction on the fragment below the fracture. The degree of traction to be exercised rests

entirely in the surgeon's hands. The front of the plaster bandage may then be removed by cutting two lines down the front and removing a lid, which allows the fracture to be inspected and its progress to be noted. In certain cases in which it has been used it has been possible to correct over-riding of the fragments which resisted other methods of treatment.

The method in a word consists of the application of a plaster leg bandage made artificially longer than the leg, and then making traction by means of a sticking plaster extension to pull the part below the fracture down, while the part above it is held firmly in the bandage.

XV.

A CASE OF CANTHARIDES POISONING WITH A STUDY OF THE URINE.

By Ralph Emerson Stevens, M.D., *House Physician, First Medical Service.*

The following interesting case, here reported, was admitted to the service of Dr. Vincent Y. Bowditch, to whom the writer is indebted for permission to report. The writer is also indebted to Dr. J. Bergen Ogden for his numerous suggestions in connection with the study of the urine.

H. P. B., a salesman, twenty-three years of age, and married, was admitted to the hospital at 6.45 P.M., May 19, 1898.

At 3.30 P.M. on the same day, the patient said that he had taken (by mistake) about half a teaspoonful of the powdered cantharides.

Other than a slight smarting in the mouth and along the esophagus, the patient noticed nothing unusual until about one hour later, when two blisters appeared on the dorsum of the tongue. Then salivation commenced and the esophageal and epigastric pains became more intense.

He then visited a physician who gave him warm water as an emetic, emesis followed three times, the last containing a small amount of blood.

On entrance to hospital, his expression was anxious; he was livid, frequently beating his chest and complaining of a burning substernal pain. Lukewarm water was administered freely; the patient vomited frequently, the vomitus containing mucus and streaks of blood. Swallowing caused intense pain in the epigastrium and along the course of the esophagus.

One-half hour after entrance, he urinated for the first time; the urine causing a burning pain in the urethra.

Then commenced a picture which was terrible to behold. First there was dysuria and in a few minutes strangury in its severest form. The patient suffered terribly, writhing and rolling all over the bed. The next subjective symptom

was cutting pains through the lumbar region. About 7.30 syncope occurred, lasting a few minutes.

The patient's condition became extremely critical. He was almost pulseless, extremities cold, cold clammy perspiration, constant nausea and frequent attacks of vomiting.

It was almost impossible to keep him in bed. One would no sooner get him covered with blankets and surrounded with heaters than he would jump up and out of bed, and attempt to urinate — perhaps passing, in intense agony, only a few drops of urine.

The first urine passed after entrance, showed the color normal, specific gravity 1,017, reaction acid, albumin, very slight trace. Microscopical examination of the sediment showed numerous small round cells resembling renal cells, normal blood corpuscles, a few dense medium round cells as from neck of bladder, a few squamous cells, a very few hyaline and fine granular casts of small diameter.

For nearly twenty-four hours after the poison was taken the product of each micturition, excepting one or two which were lost, was collected and examined, and the results are given in the following table:

Table I.

	Color.	Time specimen collected.	Amount secreted. c.c.	Albumin (estimated quantity). Per cent.
1.	Slightly smoky.....	10.10 P.M.	15	¼ to ½
2.	" "	10.25 "	15	* ½
3.	Very "	11.30 "	30	½ to 1
4.	Bloody	20th. 4 A.M.	30	¼ to ½
5	"	4.45 "	30	* ½
6.	"	5.25 "	30	¼ to ½
7.	Slightly bloody	6.15 "	30	¼ to ½
8.	" "	9.40 "	150	* 1
9.	Bloody	11.30 "	150	½ to 1
10.	"	1.30 P.M.	370	* ¼
11.	"	4 "	285	¼ to ½

This table shows the frequency of micturition with the quantity passed each time, the change of color, and the estimated quantity of albumin obtained by the nitric-acid test (a half wine-glass of filtered urine carefully underlain with a third the volume of nitric acid, poured from the bottle). Four quantitative tests for albumin were made (marked with *); these tests showed that the estimated quantities were not far from correct. The change of color is interesting; at first the color was slightly smoky, the sediment showing microscopically only a small amount of abnormal blood and very little normal blood. During the interval between 11.30 and 4 A.M., the patient slept most of the time. At 4 A.M. the urine was bloody (color of bright arterial blood), and it retained this color for three days, although containing less blood on the third day than previously.

The quantity of urine (763 c.c.) eliminated in the first eighteen hours is not without interest, showing an absence of one of the early symptoms of cantharides poisoning; *i.e.*, almost complete suppression of urine.

The sediments of these specimens were examined microscopically, but without reference to any detailed report. They contained chiefly normal and abnormal blood, frequent leucocytes and squamous epithelium both free and in clumps, a marked excess of renal cells, and a relatively small number of hyaline and granular, brown granular and epithelial, mostly with blood adherent, and rarely a blood cast.

The writer was able to make a study of five daily twenty-four hour amounts of the urine while the patient was at the hospital.

Table II.

DATE.	Amount.	Color.	Reaction.	Specific Gravity.	Urea.	Estimated Albumin.	Sediment.
May 21	cc. 1,390	Bloody	Acid	1,023	1.77 %	¼ %	Many normal and abnormal blood corpuscles, numerous uric acid crystals, a few small round cells highly pigmented, a few squamous cells and cells as from neck of the bladder, rarely a hyaline, fine granular, brown granular, eipthelial and fibrinous cast; some casts with much blood adherent. Squamous cells in sheets, covering two or three fields of the microscope; occasional clump of small round cells. Shreds of fibrin. A few small candate cells (superficial layer of pelvis).
May 23	1,700	Bloody	Acid	1,021	2.65 % 45.05 grms.	⅛–¼ %	Much normal and abnormal blood, many pus corpuscles, numerous small round cells, a very few hyaline and fine granular casts, rarely a squamous cell.
May 24	1,400	Bloody	Acid	1,014	1.75 % 27.30 grms.	⅛ %	Much normal and abnormal blood (but decidedly less than yesterday); numerous renal cells and pus corpuscles, free and in clumps, a few hyaline, fine and coarse granular casts, rarely a brown granular cast; some elements with fat adherent.
May 25	950	Smoky	Acid	1,017	2.14 % 22.80 grms.	1-10 %	Numerous normal and abnormal blood corpuscles, many small round cells, like renal cells, and pus corpuscles; rarely a squamous cell and very rarely a hyaline and fine granular cast.
May 26 ...	400	Slightly smoky	Acid	1,015	1.39 % 5.36 grms.	Very slight trace	Numerous normal blood corpuscles (more than yesterday) and a few abnormal blood globules, many small round cells like renal, and pus corpuscles, a few squamous cells, a very few hyaline and fine granular casts, and one blood and one fibrinous cast.
June 1....	900	Normal	Very acid	1,023	2.27 % 20.43 grms.	Slight possible trace	Numerous pus corpuscles, a few renal cells, rarely a normal and abnormal blood corpuscle, no casts seen.

A study of the above table will show the effect of the poison on the kidney and the rest of the urinary tract. The urine shows evidence of an acute hemorrhagic nephritis as well as an inflammation of the tract below the kidney, especially the bladder.

This table shows that, following the first twenty-four hours, there was a rise in the daily 24° amount of urine to 1,700 c.c. on the third day, and then a gradual fall to 400 c.c. on the sixth day, at which time the patient left the hospital. Likewise, a rise of urea to 45.05 grammes on the third day, and then a fall to 5.36 grammes on the sixth day, but without unusual or untoward symptoms.

There was a comparatively small number of casts. There was some involvement of the renal pelvis as shown by the pelvic cells (small caudate). It was interesting to note the appearance of the pus corpuscles in large numbers on the third day, and that they were still present on June 1 (the twelfth day). No doubt the greater part of the pus had its origin in the renal tubules and pelvis, and was the direct result of the severe acute congestion.

The presence of the large sheets of squamous epithelial cells found in the first twenty-four hour urine together with the blood, some of which was probably from the bladder, shows the effect of the poison on the bladder mucous membrane.

The examination of the urine on June 1, the twelfth day, shows that the kidney had nearly recovered from the effect of the poison, as no casts and only rarely a red blood corpuscle were seen in the sediment.

It was hoped that this case could be followed to complete recovery, but all efforts to communicate with the patient after he left the hospital were without avail.

Unfortunately, from a scientific point of view, the urine was not tested for cantharidic acid. But this cannot be seriously regretted, since the history of taking a large dose of cantharides was without question.

The following notes are taken from the hospital records:

May 21. Patient has less pain in esophagus and epigastrium; the blister on dorsum of tongue is healing rapidly.

Micturition is frequent; there is pain before, during and after micturition. The urine is bloody.

May 22. There is less pain in esophagus and epigastrium than yesterday. Patient sleeps poorly; urine is bloody.

May 23. The pain has entirely disappeared in esophagus and epigastrium. Micturition is frequent day and night. Patient given solid food. During micturition there is pain at the end of the penis. Urine clear at the beginning of urination, but at the end a little pure blood and some clots of blood are passed.

May 25. The urine is gradually clearing, there is still a little blood at the end of micturition. Patient swallows solid food with no apparent difficulty.

May 26. Patient feels "perfectly well" and insists on going to his home; he was discharged, relieved, at his own request.

In the treatment of this case the following plan was followed:

As soon as case was admitted, emesis was excited by copious draughts of warm water; the patient was given a *hot* tub bath and then put into bed and the body surrounded with heaters. Mucilaginous drinks were administered hourly. Normal salt solution was given per rectum. For the first three days no solid food was given, the patient being nourished by nutrient enemeta. On the fifth day potassium acetate was given in thirty-grain doses every four hours and continued until patient was discharged.

This is a mere report of the case without any attempt at the literature. In glancing over some reported cases of cantharides poisoning, one is surprised at the violence of the poison. One writer reports death from chewing a piece of the emplastrum cantharidis, four inches square. Another, from smearing the body (by mistake) with blistering ointment. Again, in a case of acute pleurisy where a large plaster was applied to the side, the patient had symptoms of irritation in the urinary passages and, after falling into a state of great collapse, died. Another case is reported where twenty-four grains of cantharides proved fatal; one ounce of

the tincture of cantharides killed at the end of seventeen days in another case; again, a case is reported of a child who vomited the whole mucous membrane of the esophagus after taking one drachm of the tincture; another case is reported of a man, sixty years old, who had taken approximately 75 centigrammes of cantharidin, death occurring in fourteen hours. In this last case cantharidic acid was obtained from extracts of the stomach, intestines and liver.

In closing, the writer would say, that the following observations were to him especially interesting, and in many respects differed from the literature on the subject:

1. Absence of suppression of urine.
2. There was no priapism, seminal emissions nor erotic excitement.
3. There were no signs of gangrene of the genitals.
4. There was absence of bloody stools.
5. Rapidity of onset and recovery from the poison.
6. Thirst was not a prominent symptom.